

**Equity issues regarding the CO<sub>2</sub> emissions property rights  
under the FCCC**

Jesús RAMOS-MARTÍN

Email: [jesusramosmartin@yahoo.es](mailto:jesusramosmartin@yahoo.es)

<http://www.geocities.com/jesusramosmartin>

Supervised by

Dr. Matthew Paterson

School of Politics, International Relations  
and the Environment  
Keele University

Submitted in part fulfilment of the Degree of  
MA in Environmental Politics  
1<sup>st</sup> September 2000

## INDEX

I.	INTRODUCTION	2
II.	CLIMATE CHANGE POLITICS	5
	FCCC	5
	The Kyoto Protocol	6
III.	EQUITY AND CLIMATE CHANGE	7
	Equity and CC in the literature	7
	Egalitarianism	12
	The discount rate	15
IV.	ANALYSING EQUITY IN CC: MODEL AND DATA	16
	Strong sustainability	16
	Kyoto scenario	17
	Equal allocations per capita	19
	Ecological egalitarian scenario	19
	Parikh's egalitarian scenario	21
	The price of carbon	21
	Data sources	22
V.	PRESENTATION OF RESULTS	22
	Kyoto scenario	23
	Ecological egalitarian scenario	23
	Parikh's egalitarian scenario	24
VI.	CONCLUSION: 'ECOLOGICAL DEBT'	24
	Interpretation of data	24
	Kyoto scenario	24
	Ecological egalitarian scenario	25
	Parikh's egalitarian scenario	25
	Ecological debt	26
	Conclusion	27
VII.	ACKNOWLEDGEMENTS	28
VIII.	BIBLIOGRAPHY	29

"Since 1492, Europe has expanded beyond its borders and across the world – into vast areas and continents which either belonged to the peoples of the South or lay within their natural path of expansion. Eventually, in the final trade-off on the environment, development, resource transfers, and population, the right to emigration abroad must also be included to some degree. The industrial countries should seriously consider compensating the developing countries through vastly increased immigration opportunities. This would not only be equitable, but would lead to a truly interdependent world" (Hyder 1992: 336).  
"To reach and consolidate equality may be utopia, but utopia is needed to advance political ideals" (Estrada-Oyuela 2000: 2).

## I. INTRODUCTION

The present work has the intention of contributing to the debate on international justice, a current issue in the last few years. In order to tackle the topic I will concentrate on one particular case such as climate change (CC) because this is a global problem and affects both present and next generations, that is, it also has to do with intergenerational justice. The starting point is the following hypothesis: the present way of combating climate change, that is, basically the agreements reached under the United Nations such as the Kyoto Protocol of 1997, might entail an uneven burden especially for those less developed countries. It is true, however, that under the Kyoto Protocol, developing countries (non-Annex-I) have no commitments at all to limit their greenhouse gas emissions and, then, they do not have to face the costs of abating CO<sub>2</sub> emissions. So, why it might be unfair? Because of two reasons. First, it is treating all non-Annex-I countries as equal, but they have very different behaviour in terms of CO<sub>2</sub> emissions. As we will see in the last section. Singapore and Rwanda, for example, have totally different emission trends, one following developed countries, the other with much lower levels. That is, it is rewarding polluting countries among non-Annex-I. On the other hand, as it follows from the Convention and the subsequent negotiations, one likely next step in the process will be the involvement of developing countries in the control of emissions. This might take the form of some percentage limit on emissions growth that will probably lead to average per capita emissions for most of the countries below developed country levels. If this is true we will have different levels of countries depending on their per capita emissions, a situation that, as I will explain in section III, I consider unjust. So, I will try to generate some numbers to describe the uneven use of the environmental service of carbon absorption. Something that has been called by some people an 'ecological debt' (see last section). It is also my intention to support, with the data generated, those who defend that an egalitarian allocation of emission rights is fairer than the present system<sup>1</sup>. This will be done, as I will explain, by comparing the revenues generated by each system and the regions that benefit from them, in order to see whether there is any bias with any of the systems or not.

---

<sup>1</sup> As we will see in section III we can find among others Agarwal & Narain (1991); Parikh (1995); Martínez-Alier (1998, 2000); the Global Commons Institute (<http://www.gci.org.uk>); Estrada-Oyuela (2000); Christian Aid (1999) and, Gupta & Bhandari (1999).

In my opinion there are at least three reasons why the study of equity related to climate change has especial relevance:

- i) Climate change is probably the most important environmental threat after biodiversity loss<sup>2</sup>. Nevertheless, it is the most prominent one at the political and media level, as shown by the diplomatic activity by the UN around the Framework Convention on Climate Change (UNFCCC) and the media coverage especially during the Conference of the Parties (CoP) 3 held in Kyoto. Besides, it is a global issue since it does not matter where the CO<sub>2</sub> is released it will affect the same to the climatic system.
- ii) Moreover, the Intergovernmental Panel on Climate Change (IPCC) (Mills et al. 1991) recognised that reductions of CO<sub>2</sub> emissions of 60% below 1990 levels were needed in order to stabilise the climate. This fact implies that measures to be taken are urgent, especially if we compare the IPCC claim with the actual result derived in the Kyoto Protocol (a mere 5.2% of reduction for developed countries). So there is still a long way to go.
- iii) Finally, the possible consequences of climate change imply huge amounts of money, especially for the most vulnerable countries, most of them developing, such as some island states (i.e. Tuvalu, Fiji). The costs are not only derived from the consequences of actual climate change, but also from preventive measures (like dykes) to be introduced to reduce impacts. These measures will be more costly in these countries due to their lower development and scarcity of resources.

This is why it is especially important that measures to be taken would take into account some distributional justice criteria, as even the FCCC recognised in 1992: "The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity *and in accordance with their common but differentiated responsibilities and respective capabilities*. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof" (UN 1992: article 3.1, emphasis added).

Despite of being an issue of especial relevance, we cannot deal with it using conventional analysis. That is, we cannot use the scientific model of identifying the problem, dividing its causes, analysing them and providing some partial solutions, aiming at reaching the truth. Here we cannot identify the truth, not even with more research, because due to the complexity involved, the more research, the more complexity is generated. Then, we cannot use the "normal science" in the sense of Kuhn. Rather, due to the uncertainty of facts, to the fact that there are values in dispute, the stakes are high, and decisions needed are urgent (Funtowicz & Ravetz 1991: 131), a new approach to deal with these problems is needed. This is called Post-Normal science. In this new paradigm value judgements are explicit in all kind of scientific

---

<sup>2</sup> See Wilson 1993 for more details on biodiversity loss. For an objection to the importance of CC see Levy & Egan 1998 who analyse the position of the Global Climate Coalition, a group that was denying the existence of CC, and Nordhaus 1991a, 1991b, 1994, in which he presents some data using macroeconomic models to relativise its importance. But, as it has been explained elsewhere (Ramos-Martín 1998) the use of macroeconomic models to assess the emission reduction costs can lead to misleading results, due to the assumptions used. So, figures like \$800 billion to \$3.6 trillion for a 20% reduction by the year 2100 as the one presented by Manne & Richels (cited in Paterson 1996: 81; Rowlands 1995: 134) using this kind of models do not take into account the existence of no-regrets measures and other factors..

analysis. It is proposed, then, that the quality of the decision taking process has to be guaranteed rather than the final result (or truth) of the process. It follows a procedural rationality (Simon 1983). The process is the important. We look for compromise solutions (negotiated) among the stakeholders, instead of optimal solutions. This is because in these new problems, complex adaptive systems (such as human societies) are involved, and then, simple and linear solutions are no longer valid<sup>3</sup>. In this context, this work could be taken as a piece for the process of decision making. That is, since in all decisions and scientific results there are some hidden values, we directly make them explicit and state that the information here might be used with political porpoises in order to change decisions. This is, thus, part of 'politicised science', since there is no 'neutral science'.

Indeed, climate change, as an example of these new environmental complex problems, is characterised by uncertainty (Houghton et al. 1996: 23 and following). Although both the historical increase in the mean temperature and the raise in greenhouse gas (GHG) emissions are proved, there are still huge margins in the estimations of both the increase in temperature in future and the rest of impacts of CC.

Another characteristic that affects the analysis of CC is the long term involved, that has especial relevance when using the discount rate in conventional analysis to compare present and future costs and benefits. This is one of the factors why there is still uncertainty in the side of the economic costs of CC. The other is the fact that most of the externalities cannot be valued in monetary terms, they are, thus, incommensurable. However, this long term is unavoidable due to the inertia of the climatic system<sup>4</sup>.

Last, another special characteristic of climate change is that it is a global phenomenon. Indeed, it does not matter where a ton of CO<sub>2</sub> is released, since the effect on atmosphere will be the same. However, the impacts of CC are differentiated among regions, affecting more heavily to those latitudes close to the equator and to low altitudes. If this is true, we might face a problem of lack of incentives to fight CC mainly among the responsible countries, the developed ones, since they are located out of the dangerous regions.

All these characteristics make analyses like cost-benefit, in which we look for the optimal solution, invalid. Then we are forced to look for consensus solutions among stakeholders in order to cope with the complexity of the problem. Whatever the case, the solution reached has to be compatible with sustainability in the strong sense (Nöel & O'Connor 1998). In strong sustainability, there are some goods and services provided by nature that are critical to the maintenance and regulation of the systems. In our case, the activity of atmosphere when regulating the climate should be guaranteed, as I will explain in section IV. This fact imposes, then, some constraints to the range of possible solutions. This could be understood as an ecological imperative. But if we follow a holistic point of view (in which we understand that everything affects everything in the common environment) then this imperative becomes a necessary condition for human existence. Then we can say that it is also part of anthropocentric values, and no longer an ecological imperative.

---

<sup>3</sup> For an analysis of human society as a complex adaptive system, see Giampietro 1997.

<sup>4</sup> That implies that even though we could reduce emissions by 60% now, we would still face increases in temperature.

Going back to the characteristics as a global problem, many authors in the field of International Relations (Fermann 1997)<sup>5</sup> have stated that some kind of supranational governance (not government) is needed to face the problem. This is what I will analyse in the next section, dealing with the international politics of CC. The third section will deal with equity and CC focusing in the ideas of justice and burden sharing of the costs of the reduction of emissions. The fourth section will present the model for assessing equity of the egalitarian scheme and the Kyoto scenario. The fifth section will present the results of the calculations of the allocation of equal per capita permits all around the world, and finally the conclusion will analyse the data and results comparing them with some relevant figures for developing countries such as "debt service", "official development aid", and so on. This will be done in order to derive some final data to be used when claiming for the cancellation of external debt in compensation for the 'ecological debt' in which climate change and unequal burden sharing are only part of the whole.

## II. CLIMATE CHANGE POLITICS

It is not my intention in this section to make a description of the political process leading to the international agreements on CC but rather to show some relevant points for the discussion in this dissertation, so I will focus only in the FCCC and the Kyoto Protocol<sup>6</sup>.

### FCCC

The FCCC was approved on June 13<sup>th</sup> 1992 and entered into force on March 21<sup>st</sup> 1994. On 29<sup>th</sup> of September 1999 180 countries (IISD 1999: 1) had ratified it. Its article 2 states the main objective of the convention: "to achieve, in accordance with the relevant provisions of the convention, stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner" (UN 1992).

Another point that is worth to mention is when article 4.2b asks the Parties to inform about the policies and measures they are undertaking "with the aim to return individually or jointly to 1990 levels of anthropogenic emissions of CO<sub>2</sub> and other greenhouse gases not controlled by the Montreal Protocol". This ambiguous language, present throughout the Convention, might be interpreted as an implicit demand to control emissions.

Later, during the CoP 1 held in Berlin, the 'Berlin Mandate' or decision 5 was approved (UNFCCC 1995). In that mandate the CoP assumed the compromise of having a mandatory protocol by 1997. Moreover, a pilot phase until year 2000 for projects financed under Joint Implementation between Annex I countries, and on a voluntary basis, with non-Annex I parties, was also launched. The main characteristics of these

---

<sup>5</sup> See also the debate between realists and liberal institutionalists in Paterson 1996.

<sup>6</sup> To a comprehensive history of the science of CC, see Paterson 1996, mainly chapter 2; Cline 1992; Houghton et al. 1990, 1992, and 1996. See also Paterson 1996 for an exhaustive explanation of the political process before the launching of the UNFCCC in 1992.

projects (the basis for a future emissions market) is that one country invests in CO<sub>2</sub> abatement measures or enhancement of sinks in another country because is more cost-effective than reducing at home. In this pilot phase, no emissions reduction credits can be got due to its experimental character.

### The Kyoto Protocol

The implementation of the commitments imposed by the convention received strong support with the approval by consensus of the Kyoto Protocol to the FCCC (FCCC/CP/1997/L.7/Add.1, 11<sup>th</sup> September 1997) during the CoP 3. Thus, its article 3 says that: "The Parties included in Annex I shall, individually or jointly, ensure that their aggregate anthropogenic carbon dioxide equivalent emissions of the greenhouse gases listed in Annex A<sup>7</sup> do not exceed their assigned amounts, calculated pursuant to their quantified emission limitation and reduction commitments inscribed in Annex B and in accordance with the provisions of this article, with a view to reducing their overall emissions of such gases by at least 5 per cent below 1990 levels in the commitment period 2008 to 2012" (UNFCCC 1997).

Moreover, the protocol also set up the controversial 'Flexibility Mechanisms', the last of which will be analysed with more detail in this work. The mechanisms are:

- i) Joint Implementation: defined before when dealing with the Berlin mandate but now restricted to agreements only among Annex I parties, which will be able to exchange 'Emission Reduction Units' achieved by individual projects according to article 6, from year 2008.
- ii) Clean Development Mechanism (art. 12): this is the new name for the former joint implementation between Annex I and non-Annex I parties, but now the projects have to contribute to sustainable development as defined by the host country. It allows, as well, for the banking of the reductions, that is, rich countries could use the 'Certified Emission Reductions' achieved since year 2000 to fulfil with the commitments in the first period of compromise, 2008-2012.
- iii) International Emission Trading: according to article 17 the system allows the exchange of the 'Assigned Amount Units' as defined in the Annex B of the protocol, that is, the excess of reductions over the commitments. It is basically for OECD countries and only at the national level and among governments.

The flexibility mechanisms, when allowing for the exchange of emission reductions, put on top of the table the issue of property rights on CO<sub>2</sub> emissions, the main topic of this essay<sup>8</sup>. They represent, as we will see, an unjust treatment of nations.

---

<sup>7</sup> CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, HFCs, PFCs, SF<sub>6</sub>.

<sup>8</sup> After Kyoto, the most important fact has been the acceptance by some developing countries (Argentina and Kazakhstan) of voluntary commitments during the CoP 4 held in Buenos Aires in 1998. Another relevant fact was that during the CoP 5 held in Bonn in 1999 the parties reached the tacit agreement that the Protocol will be ratified by year 2002 (Rio + 10). There are still, however, some points that have to be clarified, like the issue of sinks or the compliance mechanism. These issues have to be agreed during CoP 6 in The Hague, later this year 2000.

### III. EQUITY AND CLIMATE CHANGE

The CO<sub>2</sub> absorption capacity of atmosphere, new vegetation, soils, and oceans is an environmental service in the sense that human beings need it for survival. It is a service that we can consider as critical for life in general. Once this is noticed we analyse the use of the service from a justice point of view. In common language, equity means “the quality of being fair or impartial” (Banuri et al. 1996). In the theory, it is distinguished between procedural equity (related to the process), and consequentialist equity (related to the outcome of decisions). In our case, the later is the relevant since it regards to distributive justice, and this one is the relevant from an environmental point of view. We have to find out, then, how to distribute this environmental service among humans. This question, that might seem obvious at first sight, as well as anthropocentric, it is not so. Starting by the end, if we adopt a holistic point of view (meaning that both human beings and non-humans belong to the same complex system that is the environment) then our interests are interconnected either in a direct or indirect way, since every little action that we undertake sooner or later will have consequences over ourselves. If this is so, when we take into account distributive justice among humans, we should incorporate (at least indirectly) non-human interests as well. This is what is roughly known as strong sustainability as I will explain in the next section.

Indeed, it is not a naïve question if we have a look at the present way of distributing property rights over this environmental service under the umbrella of the UNFCCC. The establishment of reduction quotas for Annex I countries (developed) implies an allocation of (*de facto*) property rights on the biosphere's carbon absorption capacity (considered a free gift in the past), because they are the only ones allowed to trade with reductions (the Assigned Amount Units) (Ramos-Martín 1999).

This scheme, so-called grandfathering since it rewards those countries with historical emissions, clashes with the idea of international justice<sup>9</sup>. This superiority of the egalitarian scheme over the Kyoto one will be defended below on the basis of two kind of arguments: a) philosophical: the rule of equity proposed by Wenz (1988: 22) and, b) practical: tackling the issue of equity is necessary for international co-operation (Rowlands 1995: 31; Young 1989a, 1989b), and this co-operation is needed to solve the environmental problem.

Under this scheme, as well, the CO<sub>2</sub> emissions from everywhere will count the same once developing countries are involved. That is, one tonne of CO<sub>2</sub> from car use in Europe or North America will be the same than one tonne equivalent from the methane from a paddy field in the South. This distortion can be corrected with an egalitarian scheme in which a certain hierarchy of emissions will be implemented, at least indirectly, as we will see.

#### Equity and CC in the literature

Before arguing in favour of the egalitarian scheme, I will introduce briefly some early work on the topic by different authors.

---

<sup>9</sup> At least with the idea of ‘parity’, that is, the principle that each human being should have equal rights, in this case with respect to access to common global resources.

The debate of equity applied to climate change politics is not new. It is my intention in this sub-section to present briefly some different approaches to the topic either because they have influenced my views or because I disagree to some extent with their aims or methodologies.

One first major contribution was that of Agarwal & Narain (1991) from the Centre for Science and the Environment in India. With their contribution they were responding to an early report by the World Resources Institute (WRI 1990) and they arose for the first time the question of the equal entitlements for CO<sub>2</sub> emissions. One relevant point they made was the fact that through an egalitarian scheme we can overtake the problem, mentioned above, that a flat percentage reduction does not discriminate between “livelihood emissions” and “luxury emissions” (Martínez-Alier 2000). Indeed, when allocating the same amount of emissions to everyone, we are, in fact, allocating a certain “minimum amount” that might be understood as the “survival emissions” they claimed for the South. We are, then, ranking emissions. This might be important for policy determination, since it allows taxing some kinds (or levels) of emissions, or the services that release those emissions.

Agarwal & Narain also defended the idea that oceanic and tropospheric sinks are a common heritage of humankind. Thus, it follows that everyone should have the same share of that global common. This share would represent the maximum amount of CO<sub>2</sub> that each country could emit. Moreover they also noted that if we are for implementing the concept of ‘sustainable development’ we cannot release to the atmosphere more CO<sub>2</sub> than the one that can be absorbed by terrestrial environment. Once that is recognised, we have to look at the net CO<sub>2</sub> emissions of that country in order to calculate its responsibility in the accumulation of CO<sub>2</sub> in the atmosphere. By net emissions they meant actual emissions plus/less the effect of the local absorption by sinks. Then, comparing the two figures, emission rights and actual net emissions, we could derive the responsibility of each country. When they did the calculations they realised that there are two groups of countries. One emits below their fair share (the maximum allowed). The other overuses the environmental service of carbon absorption.

In order to tackle the problem of overusing a scarce resource Agarwal & Narain proposed the idea of tradable permits. In such a framework, each country would have a proportional share of the total maximum CO<sub>2</sub> sequestered by natural sinks according to its population. They proposed the price to be fixed, and allow exchange between less polluting countries and dirtier ones. At the same time, they defended another price, higher, for those emissions above the maximum allowed to each country. The money earned would go to a “Global Climate Protection Fund” to be used in funding the more vulnerable countries to develop response strategies against the environmental threat. Agarwal & Narain’s proposal has the problem of encouraging population growth and this is why I will propose setting 1990 as a base year for population as well. But anyway, it was a new and enriching paper. It is, also, the one that inspired the present research. It also inspired some empirical work by Parikh (1995: 41) who found that if we apply an average price of 19\$/tC<sup>10</sup>, the annual amount of money that the North should pay to the South would be 70 billion dollars. This kind of figure will be

---

<sup>10</sup> As we will see later on, that price of 19 dollars per ton of carbon seems quite reasonable. Notice that one ton of carbon equals to 3.66 tons of CO<sub>2</sub>.

analysed in the last section in order to compare the equity under the two schemes considered here.

A similar approach, in the sense of advocating for equal entitlements per capita as I also will do, is that developed by the Global Commons Institute<sup>11</sup> under the name of ‘Contraction & Convergence’. At the Second World Climate Conference in 1990 they presented the idea of “equity for survival”, meaning that, for practical reasons (survival of humankind), we should move towards an egalitarian ethics regarding global commons.

Using data about CO<sub>2</sub> emissions for all countries in the world, the GCI shows the path of CO<sub>2</sub> emission entitlements consistent with an outcome of CO<sub>2</sub> concentrations in the atmosphere of 450 ppmv<sup>12</sup> by year 2100. This part is the one called *Contraction*. On the other hand, *Convergence* would mean that everyone has the same right, or carbon entitlement, in a defined period of time. That is, the basis is the same as that for Agarwal & Narain, but they show a ‘transition path’ towards convergence, since they admit that it is impossible for developed countries to suddenly cut CO<sub>2</sub> emissions below certain level. They are thus more realistic.

The GCI also have another good point, which is the fact that they avoid encouraging population growth by setting some constraints to population. Indeed, they treat population in Annex I countries as stable from 2000 forward, and do the same for non-Annex I from 2045 (the convergence year) forward.

One problem with the GCI proposal that I see, but that they also admit, is as follows. If we have to take the carbon budget (the total emissions allowed in a certain period of time) as ‘risk-averse’, this means that probably the agreement to follow ‘contraction & convergence’ on a 450 ppmv path is not the best one, since it will imply major environmental problems derived from sea level rise and from non-adaptation of ecosystems, as we have seen when dealing with strong sustainability. This fact leads, in our case, to take into account a tighter concentration level, 350 ppmv, as we will see for our ecological egalitarian scheme, that has been fully influenced by the GCI methodology and aims.

Anyway we have to acknowledge the GCI for reviving the topic of equal entitlements in the consecutive rounds of negotiations upon climate change, since Agarwal & Narain’s proposal was lost before Rio 1992. Moreover, this “equity for survival” is unavoidable and urgent once the importance of observing global limits to greenhouse gases is recognised, and it will be a major topic for discussion since some representatives as Raúl Estrada-Oyuela, former chairman of the UNFCCC have started to pay attention to the topic (Estrada-Oyuela 2000).

In 1992 we had one of the more comprehensive analysis on equity and climate change in Grubb et al’s “sharing the burden” (Grubb et al. 1992). There, the authors pointed that the solution for the case of climate should be negotiated, rather than technical, and this is why, after showing the different responsibility among countries for past emissions, they presented different equity rationales to frame the burden-sharing issue

---

<sup>11</sup> <http://www.gci.org.uk>

<sup>12</sup> Parts per million by volume

in the context of tradable permits. They shared the opinion that first an overall global target for emissions should be agreed. After that, emission rights would be allocated among the different countries, allowing for the exchange between them. In their theoretical approach they presented criteria for allocation such as 'land area', 'GDP', 'historical responsibility', 'equal entitlements', 'willingness to pay', 'status quo', 'reasonable emissions', and so on (Idem: 309-314). Most of these criteria were considered only for comparison purposes, but some of them are the ones that are under consideration in the international negotiations on climate change. We might think, for example, that the 'reasonable' emissions could be considered included in the equal entitlements, as has been explained before, and the 'status quo' just represents the 'grandfathering' scheme, or the Kyoto Scenario as I call it here, and will be explained later on. Moreover, they also presented some data for some of the criteria, like in the case of the equal entitlements scheme. They pointed out that this scheme would represent huge resource transfers to developing countries. Using a quite reasonable price of 20\$/tC and data for 1988 they found some relevant results. The transfers would amount 0.42% of GNP for the USA, and twice of this amount for the Former Soviet Union and Central Europe. The average transfers from the rest of OECD countries would amount 0.16% of GNP. But in the case of developing countries, the amounts to be earned would be huge, 4.3% of GNP for China and an average of 1.2% for the rest of the world (Idem: 319, 320). These numbers are more relevant when we compare them with debt service and overseas development aid (ODA), as I will do in our case in the last section. When Grubb et al. did it, they found that "the net North-South flow would roughly offset the current international flows from South to North exacted in debt service". Moreover, these transfers would be similar to ODA. These high amounts concerned made the authors say that this kind of approach appears unfeasible. But in our case, even though we agree that this kind of scheme cannot be implemented from one day to the next, and this is why we agree with the idea of contraction and convergence, with a 'transitional period', I still think that this is something that has to be done on the basis of environmental justice. This is why I will present two views of the egalitarian scheme, one more ambitious not only in the ecological goals, but also in the monetary repercussions. The other, more realistic but still egalitarian, in which tighter commitments can be implemented once the system is going on. I do not agree, then, with their pessimistic view on the equal entitlements, and I rather follow Agarwal & Narain, the GCI, and the later on mentioned NGO, Christian Aid.

Later on, the Second Assessment Report (Bruce et al. 1996) dedicated one entire chapter to the topic of equity, regarding, among other things, burden sharing. Because Michael Grubb was one of its Lead Authors, it is not difficult to understand that they followed basically his article of 1992 (Banuri et al. 1996) by analysing the same kind of allocation approaches, but without making any kind of calculations.

Indeed Christian Aid has developed an argument that I will use in the conclusion to deal with the problem of the unfair use of resources, and in particular, of carbon absorption. This is their concern with the issue of external debt that poses real problems to developing countries, since they have to allocate huge amounts of money to pay the debt service of the debt owned by the North. Money that for developed countries is a tiny part of their income. Christian Aid adopts the idea of 'equity for survival' and tries to introduce some numbers into the discussion. The numbers they generate would be part of an 'ecological debt' that the North owes to the South because

of the global overuse of resources compared to our 'fair share'. That is, they accept the idea that everybody has the same right to CO<sub>2</sub> emissions, and the basic idea of contraction and convergence. In this context, those countries that are using more than their fair share of the climate, and adding more to the damaging effects of global warming, are running up a debt to those countries that are using less than their fair allocation (Christian Aid 1999).

In order to know the fair share for every human being, Christian Aid takes the global emissions of greenhouse gases in 1990 and divide it by the population in that year, resulting in 1.15 tC per person if equally shared. But they also take into account that scientists of the IPCC called for a reduction of at least 60 per cent in emissions to stabilise the atmosphere, giving everyone an allocation of 0.4 tonnes of carbon per person per year (Idem: 7).

Then, in order to generate the number for ecological debt, they use a 'price' for every ton of carbon. They calculate the world carbon intensity, that is, they divide the global GDP by the total emissions, giving that every ton of carbon generated (in 1990) 3000\$ of added value (Idem: 7). So, they use that figure to calculate the ecological debt that the G7 owes to the South, 13\$ trillion each year (Idem: Executive summary). The rationale for such calculations is that the consumption of fossil fuels is necessary for the generation of such added value, so the marginal price should be used in calculating the value. One problem, however, is that this is too subjective, in the sense that why don't we choose the price for the average GDP generated in the North only (that probably will be higher since GDP is so), or any other price. This is why in our case I will use the price of projects that are being carried out right now, as we will see later. Anyway, this kind of analysis is necessary to generate some numbers to discuss about and compare with other standard figures like GDP.

Finally, the two later analyses use concentration levels that are far above of that recommended for sustainability reasons, this is why, even though the second asks for equal entitlements, they have not influenced the present research. The first of these is presented in Rose et al (1998). Similar in the approach to that of Grubb et al. it seems less realistic in the assumptions, since Rose et al. only made calculations without considering the appropriateness of the reductions achieved, and without justifying the prices used.

Finally, Gupta & Bhandari (1999) use the same methodology that GCI but with a different concentration goal. In this case is of 550 ppmv, far beyond the recommendation of the AGGG mentioned before. In this way they find the emissions trajectory consistent with that concentration level for all countries that shows that most of non-Annex I countries can increase emissions until year 2025.

As we can see, there are different views on how to analyse this complex issue. With some of them, like in the case of Agarwal & Narain, the GCI, or Christian Aid, I am very identified, and I have taken them as a basis for this research. The rest, specially Grubb et al. are useful since they generate some figures that might be used in policy discussions, but the ecological targets they set are too relaxed, and can only be compared to our Parikh's egalitarian scenario before any tight ecological target has been set. Anyway, if trends do not change in near future in international negotiations,

we might see that the approach to be used is going to be the present one, by using the flexibility mechanisms.

### Egalitarianism

The CO<sub>2</sub> absorption has been considered a free gift for so long, as I have said. This has been so because last time human action did not interfere with the climate regulation by the atmosphere. But when this service has become scarce (because now CO<sub>2</sub> emissions are higher than the absorption capacity) some considerations of justice arise. Actually, "people sharing the scarce good must care enough about what they receive to desire their fair share" (Wenz 1988). In this sense, it is true that some people have to yield in order other people to have their part.

Then, what principles of justice apply to solve the problem is a question that many authors have tried to answer. Beitz (1985) asks for the extension of the Rawlsian theory (the veil of ignorance) to the global level, among nations and generations. In this way we could find a solution that makes everybody happy. In his own words (Beitz 1985:305,306): "the appropriate global principle is probably something like Rawls' general conception of justice, perhaps modified by some provision for intranational redistribution in relatively wealthy states once a threshold level of international redistributive obligations has been met". The problem of this kind of argumentation is who and how makes the necessary abstraction to define the social contract. Then, from a practical point of view it is very difficult to implement. This fact will lead us to ask for egalitarian solutions because from an environmental justice point of view (i.e. equitable access both to natural resources and services and to the burden of waste disposal and pollution traded or not, that is, distributive justice) we can see a sort of environmental injustice induced by the excess of CO<sub>2</sub> emissions in rich countries when comparing with developing ones. This fact has led to the concept of 'Ecological Debt' that the North owes to the South in opposition to the external debt; I will deal with it in the conclusion. This egalitarian view is seen fairer because "when restraint is necessary to preserve the environment, it seems that everyone should receive a fair share, and be restrained to a fair degree, in accordance with reasonable principles of justice (Wenz 1988). Then the most reasonable scenario is the one that favours that all countries will have the same per capita carbon entitlement (Moltke & Rahman 1996: 345).

Indeed the egalitarian option is not only the fairer at international level, but also at intergenerational scale<sup>13</sup>. This is true because we do not need very much information to know that future generations want to enjoy their fair share of environmental goods and services (Luper-Foy 1992: 56) as we do right now.

The egalitarian solution is based, as well, in inherent rights that are linked with the initial distribution of rights. In the case of CC this initial allocation is more immediate (and relevant) and we should put more attention on it (Rose et al. 1998: 29).

However, this egalitarian solution can have two different interpretations. One is without taking into account the ecological thresholds, the other takes them into account in the following way: we should consider the 50-60% emission reduction defended by the IPCC as the basis of a global carbon budget in a defined time scale. This budget

---

<sup>13</sup> For an analysis on intergenerational justice and CC see Page 1999, in which the author presents a justification of intergenerational equity based in the obligations to future collectivities.

could be allocated on the basis of a per capita allocation for which the same base year as in the UNFCCC, 1990, could be used, avoiding thus the perverse incentives of population increase. In this way we would be tackling both the ecological goal (maintaining the ecological service) and the environmental justice objective (equity, see also Agarwal & Narain 1991; Parikh 1995). Both ways of interpreting the egalitarian solution will be analysed later on.

This defence of the egalitarian position is based on the 'rule of equity' that is "the fair share of any one person is the same as that for anyone else who is the same in all relevant respects" (Wenz 1988: 22). In our particular case the relevant aspect is the existence of the person itself. That is, the mere existence would give anyone the equal part in enjoying the environmental service.

There are, as well, two more arguments in favour of the egalitarian entitlement. First is the fact that in the early 90s per capita emissions from industrialised countries were on average 8 times those of the developing world (Grubb et al. 1992: 308) showing the injustice mentioned before. More specifically, in 1990, the USA had 5.38 tC per capita; the rest of OECD countries, an average of 2.45 tC; Eastern Europe countries 3.55 tC; India 0.22 tC; China 0.55 tC; and the rest of the world only 0.56 tC<sup>14</sup>. This fact, that describes the inequality we are facing, is against our idea of environmental justice as defined before (equal access to resources and to the burden of waste). The egalitarian approach, however, fits very well with the idea of environmental justice. So if we have now this inequality, we should move towards an egalitarian scheme to implement "the rule of equity". The second is that if we are looking for one mechanism to tackle the climate change problem this has to be accepted politically<sup>15</sup>. For that, the recognition of the different responsibility among countries is needed. Moreover it has to be a fair way.

Finally, the last argument, similar to the one presented in the "contraction and convergence" hypothesis of the Global Commons Institute (<http://www.gci.org.uk>), is the idea that some emissions are needed for economic development purposes. Thus, if today some countries are developed is in part because they have been using a disproportionate share of the atmosphere and the environmental service carbon absorption by sinks. This argument asks for the reduction in the North and the increase in the South until some equivalent level of per capita emissions (defined a priori through political consensus) is reached.

Nevertheless both the egalitarian solution and the present system (Kyoto) are political and not technical decisions, representing, then, different interests depending on the country. It is clear that the first option is fairer for those countries with low emission levels, most of the developing countries. Thus, it cannot be understood why these countries are not defending such approach in the international negotiations. On the other hand, the second scheme benefits mainly developed countries, Eastern Europe countries, China, and India, as I will show in section V. But in the case of the last two, they would be better off if the egalitarian solution is implemented, so we cannot say that it represents their interests.

---

<sup>14</sup> Own calculations. Note that we are using the six regions as defined in chapter 4.

<sup>15</sup> For further development of this point see Young 1989a,b.

The pragmatic case for equity is explained as follows. Due to both the especial characteristics of climate change and to the strong interests behind the position of each country, the solution adopted by the international community must be under consensus among the stakeholders in order to be accepted by anyone<sup>16</sup>. More international co-operation is needed then, since isolated actions by governments are useless. In this way, and following liberal institutionalists in the framework of International Relations, we can say that the strength of the role of the FCCC is necessary because otherwise "with the lack of a supranational authority capable of imposing solutions in the best long-term interests of the collective states, international co-operation on the management of climate change is limited by the least common denominator of what states are capable to agree upon" (Fermann 1997: 30)<sup>17</sup>.

Moreover, these strong institutions are needed to solve the problem of equity, for example, by tackling the asymmetry that we see by which most vulnerable countries are, as well, the less responsible and the ones with less resources for combating global warming. Thus, authors like Rowlands (1995: 31) suggest that an "adequate resolution of North-South issues – that is, developing countries' concerns about 'equity'— is necessary for international co-operation". Nevertheless, that co-operation has to be based in a voluntary basis and never be forced.

Co-operation may also be seen as extremely important to legitimate the decisions taken, and it has to start by the agreement on the level of concentration at which to stabilise, the emissions trajectory and an agreement on the base year (Gupta & Bhandan 1999: 735). It might also be useful to justify the existence of a social order perceived as just (Wenz 1988: 16). That is "discussions of the nature and principles of justice are therefore a practical necessity" (idem) in order to achieve the needed co-operation. In this case, then, 'environmental public policies', and here we can include international measures such as those adopted under the FCCC, should embody principles of environmental justice that people consider reasonable.

We have seen that these ideas of justice and co-operation can be defended from a practical or functional point of view. They are necessary to solve the problem. This is so because the environmental service carbon absorption is scarce, as I said before. Being scarce, this service gets a potential economic value that has to be materialised. If not, then rich countries will consider, as they have been doing until now, the service as a free gift and we will face an overuse. This is a typical example of the 'tragedy of the free access goods'. That is, the property rights of the resource are not guaranteed, and then we can see deterioration in the service.

The historical responsibility in the overuse of the service explains the fact that some countries are also overdeveloped, and legitimates the claim from developing countries that the first step has to be made by developed ones (Grubb et al. 1992; Shue 1994; Hyder 1992). They ask this first step from developed countries not only because of their responsibility in past emissions but also because of their need for further development. From these claims it derives the idea of equal entitlements per capita, based in the uneven distribution of emissions that we have presently. Thus, in 1990, the

---

<sup>16</sup> For an analysis on non co-operation and free-riding in the context of CC see Ward 1996.

<sup>17</sup> On the contrary, realists assume that co-operation can be successful only in presence of an actor who has a preponderance of Power (Rowlands 1995: 14). In our case it is difficult to see either the USA or the EU as this actor. It might be possible, however, to see the EU leading the process, but not on the basis of power. See also Oberthür & Ott 1999: 267-269.

USA and the USSR, with 10% of world population, emitted 40% of global CO<sub>2</sub> emissions (Agarwal & Narain 1991).

On the other hand, even though the level of emissions in developing countries is still low, some of them do not reflect improvements in the quality of life or increase in population. Rather, a growing share of these emissions are due to the externalisation of the most energy intensive (and then CO<sub>2</sub> intensive) industries to southern countries, in what would be another example of the generalised internationalisation of environmental externalities. Mielnik & Goldemberg (1999) have shown this idea for the case of CO<sub>2</sub>. Annex I countries to the FCCC would be 'decarbonizing' (when comparing to GDP), whilst non-Annex I would be 'carbonizing', basically due to 'surrogate emissions' (Kopolo 1999), that is, those emissions in developing countries generated when producing goods and services to be consumed in the North. This idea of the new ecological imperialism (through shifting polluting firms to developing countries) was introduced for the first time by Agarwal & Narain (1991: 24) when they said that part of the emissions of the third world (basically from natural gas and deforestation) are not due to consumption in the South but in the West (meaning the North).

#### The discount rate

Finally, I have to mention the issue of the discount rate, since I will analyse intertemporal monetary flows, because CC affects different generations, and has different temporal scales. The discount rate might be defined in economic terms as the return of the present consumption that is sacrificed to obtain future consumption. Or in an ideal world without market failures, the interest rate or the return of the capital investment in a competitive market. Most of the economists make the mistake of trying to solve with the same rate of discount the problems of intragenerational efficiency and intergenerational distribution (Norgaard & Howarth 1991) without realising that is the distribution of income and wealth the one that generates the discount rate (depending on the preferences and budgets of the economic agents). Then, the discount rate is not fixed, but variable. Moreover, it depends on a political decision, the initial distribution or allocation of resources.

When realising about that, we can see that there is no optimal rate. We have to introduce, then, the concept of Social Rate of Time Preference (SRTP). This one is composed by the pure temporal preference ( $\tilde{n}$ ) and a rate that takes into account the decreasing marginal utility of consumption ( $\hat{e}g$ ).  $SRTP = \tilde{n} + \hat{e}g$  where  $\tilde{n}$  is the pure temporal preference,  $\hat{e}$  is the elasticity (or per cent change) in marginal utility of consumption, and  $g$  is the GDP per capita growth rate. Thus, even the first economists who used SRTP in collective decision processes, like Ramsey (1928), defended that  $\tilde{n}$  should be zero because of a question of equity that should be extended to those who will live in future. That is, they considered society as a continuum in time. Presently, in the case of CC we can find in the literature (Spash & d'Arge 1989; Cline 1992; Solow 1992; Azar & Sterner 1996; Azar 1998) similar views to that of Ramsey, that defend  $\tilde{n}$  equal to zero because of intergenerational justice.

In this way, assuming that the elasticity of the marginal utility is equal to 1, the only explanation for the discount rate is the rate of growth. But is this growth sustainable? Probably the answer is NO, since we are not taking into account the degradation of the environment for its calculation, so it might be that the rate should be lower than the

growth rate, even zero. In the case of CC, Brown (1997) says that, from a point of view of economics as stewardship of a common inheritance of humankind that we have to keep, the political imperative is to maintain the equilibrium between carbon sources and sinks, then we have to adequate the economy to these limits imposed by the physical world (that is, strong sustainability but with other words). So, we have to understand that there are some goods and services (and climate regulation is one of them) that do not depreciate over time, and then discounting is meaningless. I will compare, then, monetary flows in 2010 with monetary flows in 1990, without discounting.

In conclusion, we have seen that CC has a few characteristics that allow the introduction of concepts of distributive justice like environmental justice. Particularly, I have defended that one way of tackling both aspects is by implementing equity when considering the environmental service carbon absorption, that has a practical translation when we admit that rich countries have an historical responsibility regarding CO<sub>2</sub> emissions, so they should reduce first the emissions and converge with developing into same per capita levels. With this solution we will avoid the tragedy of the free access goods, that is, the overuse of the environmental service. No doubt this will require more international co-operation and some kind of compliance mechanism capable of guaranteeing that the reductions are done. Last, I have argued against discounting monetary flows in the case of CC because of intergenerational justice reasons.

The next section will present the model analysed here, equal entitlements of CO<sub>2</sub> emission rights, as well as some alternative models. I will explain, as well, how to obtain the data.

#### **IV. ANALYSING EQUITY IN CC: MODEL AND DATA.**

“Because the climate system is owned by no one, and yet needed by everyone, it is only fair that we should all have an equal stake in the services it provides and in its protection” (Christian Aid 1999: 1).

In this fourth section strong sustainability and the ecological limits that imposes to the action against climate change will be analysed. Moreover, I will introduce some analysis that can be found in the literature on equity and CC. Then, the model to analyse the Kyoto Protocol will be presented, followed by the egalitarian model in its two approaches.

##### Strong Sustainability

As stated earlier, article 2 of the Convention describes the main purpose of the agreement that is basically non-interference with the climate system. If we consider the climatic system as an ecological service we need, then we can say that article 2 is claiming for one sort of strong sustainability<sup>18</sup> (as defined before) applied to climate change.

---

<sup>18</sup> By opposition to strong sustainability, marginalist (or orthodox) economists defend the concept of ‘weak sustainability’ in which the aim is to maintain constant or rather increase welfare (understood as

Developed countries are clearly not going to reduce the CO<sub>2</sub> emissions by the 30-60% required to stabilise atmospheric concentrations immediately. Even if that was done, this fact would lead to some warming due to the atmospheric forcing already produced, but this would be less harmful than without emissions reductions, so anyway we have to face some degree of global warming. In this context, as Hare (1998: 4) says, “minimizing the rate of climate change is a fundamental aspect of climate policy and this constraint plays a major role in defining the time path of emission reductions, and hence on the rate at which a ‘carbon budget’ is consumed”. This is the reason why, in order to investigate the ecological constraints to climate change (i.e. our practical definition of strong sustainability), the WMO/UNEP Advisory Group on Greenhouse Gases (AGGG) produced in 1990 an analysis of quantitative risks for human and natural systems regarding rates and total amounts of temperature rise and sea level rise. The temperature and sea level rise targets for the lowest level of risk<sup>19</sup> were:

- Maximum 1.0°C increase above pre-industrial levels. Increases beyond this “may elicit rapid, unpredictable and non-linear responses that could lead to extensive ecosystem damage”.
- Maximum rate of warming of 0.1°C/decade. The rate of warming has to be below this to ensure that most ecosystems can adapt. This would lead to some damage, however higher levels would lead to rapidly rising risk.
- Maximum rate of sea level rise of 20mm/decade. This “would permit the vast majority of vulnerable ecosystems, such as natural wetlands and coral reefs to adapt with rates beyond this leading to rising ecosystem damage”. (Rijsberman & Swart 1990).

These limits are the same that the European Environment Agency recommended later in The Dobris Assessment (Stanners & Burden 1995) in order to guarantee ecosystems’ sustainability. These ecological thresholds are far below than the predictions of future temperature and sea level rise if no action is taken. The predictions show that global mean temperature will increase by 1-3.5°C by year 2100, and sea level rise will be between 15 and 95 cm (Watson et al. 1997). This fact might have irreversible repercussions in some of the systems. For example, in the case of forests, an increase of 1-3.5°C in 100 years is equivalent to a transfer of the biological frontier of 150-550 Km, while the natural rate is only of 4-200 Km per century (idem). Therefore, it seems to me that all analysis regarding the policies to implement for combating CC should take into account those ecological limits. Otherwise, the action taken will be useless, since we will face an irreversible loss of ecosystems. However, as we will see right now, this is not what is happening in the international debate, and this is why I will also analyse a second egalitarian scheme in which ecological limits should be part of the negotiation.

### Kyoto Scenario

By this scenario I mean the one based on the use of the mechanisms defined before, joint implementation, the clean development mechanism, and international emissions

---

wealth or consumption). This concept is based in the complete substitutability between nature and man-made capital. See Cabeza 1996 for an exhaustive analysis of weak sustainability.

<sup>19</sup> The one we have to take into account if we follow the ‘precautionary principle’ as the Convention asks in its article 3.3.

trading, that is, the Kyoto Protocol. Despite its importance, there are no studies on the possible size of the market for CO<sub>2</sub> emissions but the one made by Zhang (2000). In this article, the author divides the world into twelve regions. I reduce his division to six to make it comparable with the analysis I will make. The regions are The USA, Other OECD (O-OECD), Other Annex I (O-Annex-I), India, China, and rest of the world (RW). He takes into account the emissions in the base year<sup>20</sup>, year 2010 as a representative of the first period of commitments (2008-2012), as well as the six gases defined in Annex A of the Protocol.

He compares the emissions in 1990 with those predicted in the business as usual scenario of each country in their National Communications<sup>21</sup>. He also uses for each of Annex I region, the percentages decided in Annex B of the Protocol, and then compares the emission target for 2010 with the business as usual scenario, giving the reduction in emissions required for each region of Annex I. Using his methodology but the data for CO<sub>2</sub> emissions from the CDIAC<sup>22</sup> (Carbon Dioxide Information Analysis Center), we get that this requirement is, 354.46 MtC<sup>23</sup> for the USA, 138.24 for O-OECD, and 18.83 for O-Annex-I, totally 511.53 MtC per year. This amount is the emission reduction required for these three regions compared to the business as usual scenario. However, part of the reduction can be done at home, although until now there are no official commitments about this. Indeed, Annex I countries' demand for credits depends also on the extent to which the flexibility mechanisms will be allowed to contribute to meet their Kyoto targets (Zhang 2000: 12). In fact, the three articles of the Protocol defining the flexibility mechanisms include words saying that the use of the mechanisms must be supplemental to domestic actions. This is why Zhang analyses different scenarios with different ceilings on the use of the mechanisms, including the proposal of the EU (1999) of 50% for the buyer. But here, I adopt his case of total flexibility in the use of the mechanisms. Maybe this is a radical assumption, but I think it is also very likely<sup>24</sup>. This is, at least, what it seems from the recent declarations of the under-secretary for global affairs of the USA, Frank Loy, to The Guardian<sup>25</sup> in which he says that unless Europe gives way and allows the US unlimited rights to trade internationally in so-called "carbon credits", it will not fulfil "a large fraction" of its obligations. So, with this assumption, Zhang runs a model based on marginal abatement costs for different countries and finds that 27.6 % of the total reduction requirements can be reduced at home, 16.9 % represents 'hot air'<sup>26</sup>, 8.34 % will be the demand for Joint Implementation and Emission Trading, and 47.06% for the Clean Development Mechanism. Moreover, when he runs the model he also finds the marginal cost of abatement that can be considered the 'price' to be paid for the emission reductions. That price is 9.6\$/tC when there are no limits for trading with the

---

<sup>20</sup> 1990 for all Annex I countries but Bulgaria and Romania that take 1989; Hungary that takes the average between 1985 and 1987; and Poland 1988.

<sup>21</sup> Official document that each party to the UNFCCC has to submit reporting current emissions and policies undertaken to reduce them.

<sup>22</sup> <http://cdiac.esd.ornl.gov/home.html>

<sup>23</sup> One MtC is one million tonnes of carbon.

<sup>24</sup> Oberthür and Ott 1999: 200 say that "the political prospects of a quantitative ceiling on the Kyoto mechanisms are not very promising", since (page 204) "neither the US nor the other members of JUSSCANNZ group will ratify the Protocol without the possibility of meeting a substantial part of their quantified targets by trading".

<sup>25</sup> The Guardian, Saturday July 22<sup>nd</sup> 2000. <http://www.guardianunlimited.co.uk>

<sup>26</sup> Reduction in emissions due to economic crisis (and the subsequent less use of energy) rather than to the introduction of abatement measures.

flexibility mechanisms. When he applies the model to the different regional capabilities of CO<sub>2</sub> reduction, he gets, as well, that in the case of the CDM the allocation among regions is as follows: China gets 60.3 % of the credits, India 15.1 %, and the rest of the world 24.6 %. With those figures we can calculate the earnings for those countries derived from the present way of tackling the problem, the use of flexibility mechanisms when applying the agreed price of 20 \$/tC. These figures will be compared with those I will get when analysing the egalitarian schemes.

I do not think, however, that this is the best approach to deal with climate change. From the point of view of the environment, the impact of the 5% reduction below 1990 levels on the rate and pace of climate change is modest at best (Grubb et al. 1999: 158; Oberthür & Ott 1999: 273). Also, as Estrada-Oyuela (2000: 5) points, it is very difficult to bring equity considerations with a scheme that only implies limitation or reduction targets as percentages of 1990 emission levels. Indeed, it implies that past pollution should be rewarded by the right to continue indefinitely with minor reductions. This kind of approach is difficult that can attract developing countries since they will consider it as unfair (Grubb et al. 1992: 318), because they will be constrained to lower emissions than developed countries.

Moreover, another pitfall from the point of view of equity is the fact that even if some projects are carried out this will only benefit some countries, basically Eastern Europe (including former USSR), China, and India, as the figures using Zhang's methodology will show. This is why East European countries supported the idea of commitments and Joint Implementation as a way of attracting investment to replace their infrastructure. This is the worry that some countries have (Zayalova & Michaelowa 2000: 6), mainly in Africa where they think they cannot get credits for projects since they only represent 3% of global energy use, and, actually, they *must* increase emissions in order to develop. Thus, if the present system continues, it will represent that developed countries are allowed to pollute more than developing ones, and will also represent that only a few developing countries will benefit from the credits achieved by emissions reductions. This is what is happening now with the present Joint Implementation Pilot Phase launched by the UNFCCC in 1995. Most of the projects (77 out of 109) have gone to Eastern European countries, that is, two thirds of the funds (Oberthür & Ott 1999: 162) showing the unequal allocation of projects around the world.

#### Equal allocations per capita

Apart from a Brazilian proposal on the topic (Grubb et al. 1999: 271-2) the issue of equal entitlements per capita rather than commitments to reduce or limit emissions has not been taken into account in the negotiations. However, as Estrada-Oyuela (2000: 3) admits, an analysis of contraction and convergence is a must if equity is going to be taken into account. In our case I will present two approaches for the egalitarian scheme. The first will take into account the ecological limits defined before. The second will leave open the question of emission limits and reductions to further negotiation, but it will tackle the equity issue from the beginning.

a) *Ecological egalitarian scenario*: this model can be considered basically a mixture between the 'contraction and convergence' idea of the GCI, and 'The Carbon Logic' of Greenpeace (Hare 1998).

Since 1990 the IPCC has adopted an estimate of the warming that would occur if CO<sub>2</sub> concentration is doubled and the climate allowed to stabilise (i.e. the climate sensitivity) of 2.5°C, with a range of 1.5-4.5°C, but scientific evidence is showing that maybe the sensitivity is higher. So, from a precautionary policy perspective we use a climate sensitivity of 3.5°C. If no action is taken, this sensitivity would represent a warming of 3.0°C above the pre-industrial levels, and sea level rise of 55-60 cm above 1990 levels (Hare 1998). Thus, if we adopt the logic of strong sustainability as I defended before, major reductions are needed in order to fulfil the ecological limits. That is, we have to find a concentration level and emission path that guarantees that we are always below the ecological limits. A 1.0°C limit requires, according to Hare (1998), that the concentration level is below 339 ppmv for a climate sensitivity of 3.5°C.

Alcamo & Kreileman (1996) have calculated, using the IMAGE<sup>27</sup> model, the effects of stabilising at the different levels of concentration, showing that stabilisation above 450 ppmv will have large impacts. In summary:

- Under the 350 ppmv scenario sea level rise is 24 cm in 2100 and the temperature increase is 0.7°C (1.2°C above pre-industrial levels)
- For the 450 ppmv the temperature increase is 1.7°C above pre-industrial levels, and sea level rise 29 cm.

With these data, it seems obvious that the best scenario to be taken into account from a precautionary point of view is that of 350 ppmv, because is the one among the studied that guarantees that ecosystems could adapt to the changes in the environment. Then, Greenpeace conducted some research to try to find what is the 'carbon budget' that allows for that concentration level, and they found that corresponds to 110-340 GtC<sup>28</sup> with the central estimate being 225 GtC<sup>29</sup>. This value is the carbon budget for the period between 1990 and 2100. The target seems very stringent, but some work from Alcamo & Kreileman (1996) shows that if emissions in 2010 are 37% below 1990 levels (for Annex I countries), we will only need a reduction of 2% every year (for all countries) beyond 2010 to fulfil the ecological limits. In our case, however, I am not interested in the feasibility of such reductions, but in the economic consequences for developing countries. So I will divide the carbon budget by the number of years and by the population in 1990 to obtain the maximum level of emissions per capita that is allowed each year. This value is 0.37 tC per year per capita. With this data I will calculate how much CO<sub>2</sub> developed countries are over-emitting, and how much they

---

<sup>27</sup> IMAGE is the Integrated Model to Assess the Greenhouse Effect, developed and applied by RIVM (National Institute of Public Health and the Environment, in Holland) over the last decade to address issues of global environmental change. Scientifically speaking, IMAGE is aimed at evaluating the relative importance of major processes, interactions and feedbacks in the society-biosphere-climate system, and estimating sources of uncertainty in such a complex system. The policy goals are to provide: i) a dynamic and long-term perspective on the consequences of global change; ii) insight into the impacts of global change and iii) a quantitative basis for analysing the effectiveness of various measures to address global change. <http://www.rivm.nl/image>

<sup>28</sup> One GtC equals one billion tonnes of carbon.

<sup>29</sup> These numbers, as well as all numbers used in climate change literature, have great uncertainty, due to the characteristics of this complex problem. Here the authors estimate them to be in the order of 50%. It's a pity that we cannot find this kind of warnings in the rest of sources used. If so, comparison would be better.

should pay to those countries that are using less than the average. In order to calculate the value of the money transfers, we should apply a ‘price’ that I will find in later on.

When we have the value of the ‘ecological debt’ I will compare it to some indicators relevant for developing countries such as debt, GDP, ODA, and debt service. But I will also compare with both the numbers obtained for the Kyoto Scenario and for the second egalitarian scheme. In this case, however, I will use the price defined below rather than the one proposed by Zhang, in order to guarantee the consistency of the analysis.

b) *‘Parikh’s’ egalitarian scheme*: here I take the considerations that Parikh (1995) made before and I divide CO<sub>2</sub> emissions in 1990 by world population in that year, resulting an average emissions of 1.13 tC per capita. Then, I calculate the maximum emissions for every region using this per capita value, and then I compare the maximum allowed emissions with the actual ones, in order to get the overuse or underuse of the environmental service. Then, I apply the agreed price of 20 \$/tC and I find the monetary flows that such a system would imply. The rationale for that scheme is that a minimum condition for any world-wide agreement is to tackle the issue of equity among the stakeholders. Once this is recognised, we could propose some flat emission reductions in per capita terms in further negotiations (like in the Kyoto Protocol), but always guaranteeing that everyone has the same right of using the environmental service carbon absorption. In this way, as in the ‘ecological egalitarian scheme’, all Parties to the Convention would have incentives to reduce or not increase emissions. Indeed, Annex I countries would have incentives to reduce emissions in order to avoid compensatory payments, but also non-Annex I countries would have such incentives in order to be able to sell their *rights* in an international market. This scheme is, *a priori*, less ambitious from an environmental point of view, but maybe is more reasonable as a first step for tackling equity and ecological targets in the international negotiations. Further on, once some reductions are achieved and the scheme is going on, we should consider the stringent ecological thresholds defined before.

### The price of carbon

As well as for the case of the market for flexibility mechanisms, there are no specific studies of the possible price of a tonne of carbon in a possible future international market, but almost all articles on the topic mention some figures derived from parallel analyses. The range of prices that I find is between the 9.6 \$/tC that we see in Zhang (2000) and 118.8 \$/tC in the Green Paper of the Commission (CEC 2000). Of course these are just extremes and are based on theoretical calculations using different sort of models. This is why I propose to use the values that we can find in actual projects that are being implemented presently. When doing so I also find extreme values. Usually very cheap projects are those that focus on the forestry sector, and expensive ones those that focus on introducing renewable energies (i.e. solar photovoltaics). But when we look at the majority of projects, we realise that most of them show similar figures, around 20 \$/tC<sup>30</sup>, the figure Parikh used for her calculations that I presented before. So,

---

<sup>30</sup> In Joint Implementation Quarterly Vol. 6 number 1 (2000), page 5 we can find a project in India in the power sector with values around 18 \$/tC. In the US Initiative for Joint Implementation web page, <http://www.ji.org> we found the “Taquesi river hydroelectric power project” with 28.8\$/tC, and the “CAPEX SA power generation project” with 23.7 \$/tC. Moreover in the World Bank’s Prototype Carbon Fund web page, <http://www.prototypecarbonfund.org> we find the “Liepaja solid waste

in our case, in order to make the comparisons I choose this price for carbon emissions. Anyway, the relevant is not only the absolute value of the transfers involved, but also their distribution among countries.

To find the price of a ton of carbon, however, is not so easy. As Martínez-Alier (2000) points out, when the commitments are small, like in the Joint Implementation projects analysed, the price will be low because the demand for sinks will be small, but also because local externalities are not taken into account, or there is huge supply. On the contrary, when the commitments are of the order of 3000 MtC per year, the marginal costs of the CO<sub>2</sub> abatement would increase enormously. Although, if the owners of carbon sinks are poor, the price will still be low. As we can see, all this uncertainty makes also our calculations mere approximations.

#### Data sources

In the case of the data for the Kyoto Protocol scenario, Zhang analyses official information contained in the National Communications of the different countries to the UNFCCC.

Regarding the egalitarian schemes, data on CO<sub>2</sub> emissions is provided by the Carbon Dioxide Information Analysis Center (CDIAC)<sup>31</sup>. The rest of the indicators to be used, GDP, Debt, Debt Service, ODA, and Population have the World Resources Database 1998-1999 as a source, using data from the World Bank's World Development Indicators, except for population, in which data from the UN Population Division (Annual Populations (1996 revision) median estimates) is used.

The next section will present the data derived from the analysis for both the Kyoto and the two egalitarian schemes.

## **V. PRESENTATION OF RESULTS**

In this section I will present the results for the three scenarios. These results will be analysed in the last section, comparing them with some relevant indicators that can be seen in table 1. In the second column we have the ratio between the Overseas Development Aid and the Gross Domestic Product. In the third column we have the external debt in millions of dollars, and in the next column the debt service derived. Next column shows the GDP for the six regions, and last one the ratio between the debt service and the GDP. I will compare especially debt service and last column as ways of measuring the effort that the different regions have to do to fulfil with the different commitments.

---

management project" with 23.9 \$/tC, and two projects, one in Uganda and the other in Costa Rica, with 10-20\$/tC. So an assumption of 20\$/tC seems quite reasonable.

<sup>31</sup> See note 14.

**Table 1. Characteristics of the six regions.**

	Population 1990	ODA/GDP %	External Debt 10 <sup>6</sup> \$ <sup>32</sup>	Debt Service 10 <sup>6</sup> \$ <sup>32</sup>	GDP 1990 10 <sup>6</sup> \$	Debt Service/GDP %
USA	254106000	..	..	..	4863690.9	..
O-OECD	604209000	..	..	..	9402953.9	..
O-ANNEX-I	320841000	0.25	150880.8	19767.4	837823.6	2.36
India	850793000	0.5	83862.3	8222.8	318041.9	2.59
China	1155305000	0.6	55301.4	7057	323019	2.18
RW	2097052000	10.97	974858.2	99967.4	2231882.9	4.48

Kyoto scenario:

In table 2 we can see the summarised results for the Kyoto scenario. In column 1 we have the emissions in the base year (1990) in MtC. In column 2 the emissions for the business as usual scenario that the Parties reported in their National Communications<sup>33</sup>. The Kyoto target for every region of Annex I is shown in column 3, and then in column four we find the emissions reduction required for each region. In next column we have the 'hot air', and in the last one the expected revenues for each region derived from the use of the flexibility mechanisms under the assumptions mentioned in the last section<sup>34</sup>.

**Table 2. Main results for the Kyoto scenario.**

	Emissions 1990 10 <sup>6</sup> tC	BaU 2010 10 <sup>6</sup> tC	Kyoto Target 10 <sup>6</sup> tC	Reduction Required	Hot Air 10 <sup>6</sup> tC	Revenues 10 <sup>6</sup> \$
USA	1367	1625.77	1271.31	354.46		
O-OECD	1478	1512.88	1384.89	138.24	10.25	205.00
O-ANNEX-I	1139	1064.17	1116.22	18.83	70.88	2311.76
India	186					733.18
China	638					2927.85
RW	1176					1194.45

Ecological egalitarian scenario:

Again, in table 3 we can see the major results for that scenario. In column 1 we can see the 'fair' allocation of carbon emissions for every region expressed in tonnes of carbon. The next column shows the remainder between real emissions and the 'assigned emissions'. This leads to an overuse of the resource (+) or to an underuse (-). Third column shows the monetary flows derived from the trading involved, using the agreed price of 20 \$/tC, and finally, last column shows the ratio between the expenditure or revenue and the GDP.

**Table 3. Main results for the 'ecological egalitarian scenario'.**

	Allocation of emissions tC	Overuse (+) or Underuse (-) tC	Expenditure (+) or Revenue (-) 10 <sup>6</sup> \$	(Expenditure or Revenue)/GDP %
USA	98396850	1268603150	25372.06	0.52
O-OECD	233966386	1244033614	24880.67	0.26
O-ANNEX-I	124238483	1014761517	20295.23	2.42
India	329450511	-143450511	-2869.01	-0.90
China	447365954	190634046	3812.68	1.18
RW	812036362	363963638	7279.27	0.33

<sup>32</sup> For the USA and the rest of OECD these data are not available in the sources used here. However, for the rest of our argument they are not necessary since we will compare basically the effect of the different scenarios upon developing countries.

<sup>33</sup> Remember we are applying Zhang's (2000) methodology, but using data from CDIAC.

<sup>34</sup> These are not net revenues for Annex-I countries, in the sense that even though O-OECD countries can sell their 'hot air', they still have to buy the majority of the reduction required.

Parikh's egalitarian scenario:

Quite similar to the former table, table 4 shows the same four columns but with different assumptions regarding the distribution of rights. In this case, the equal entitlement per capita is defined as the per capita average carbon emissions in 1990, as has been said before. Again, last column will be the one I will use to assess both the viability of every scenario, and the effort every region has to make to fulfil the commitments.

**Table 4. Main results for 'Parikh's egalitarian scenario'.**

	Allocation of emissions tC	Overuse (+) or Underuse (-) tC	Expenditure (+) or Revenue (-) 10 <sup>6</sup> \$	(Expenditure or Revenue)/GDP %
USA	287861079	1079138921	21582.78	0.44
O-OECD	684471263	793528737	15870.57	0.17
O-ANNEX-I	363461061	775538939	15510.78	1.85
India	963811130	-777811130	-15556.22	-4.89
China	1308774070	-670774070	-13415.48	-4.15
RW	2375621399	-11996621399	-23992.43	-1.07

In next section I will analyse the results presented here and I will derive some policy recommendations that will be related to the issue of 'ecological debt'.

**VI. CONCLUSION: 'ECOLOGICAL DEBT'**

In this last section I will analyse the data presented before, as well as I will introduce the concept of 'ecological debt' to the debate of property rights on CO<sub>2</sub> emissions, a new political topic that, no doubt, will be present in next rounds of negotiations on climate change. Finally, I will draw some final remarks and conclusions that can be derived from the analysis in this essay.

Interpretation of data:

By looking at tables 2 to 4 one can understand that different approaches to that topic might generate different results. However, when analysing different approaches one gain in robustness of the results and one can also understand better why some decisions are taken.

*Kyoto scenario:* in this scenario, following the hypotheses presented before, we are getting the possible revenues derived from the flexibility mechanisms in year 2010 (last column in table 2). According to these data, China is the country most benefited by the scheme (2927.85 M\$), followed by O-Annex-I (2311.76), Rest of the World (1194.45), and India (733.18). This position, however, changes when I take into account the revenues compared to the GDP in 1990, that is, when I do a relative comparison. Then, China, with 0.90% is still the one that gets more benefits, followed by O-Annex-I (0.27%), but the next is India (0.23%), and finally the Rest of the World with only 0.05% of the GDP.

Two major conclusions can be derived. The first is that the market is so small because the commitments here are a reduction of only 5.2% below 1990 levels, that is, small demand for CO<sub>2</sub> emission rights. The second is that these results confirm the bias that flexibility mechanisms have, as I said before. Indeed, the impact of the mechanisms on RW is insignificant. Then, it is very unlikely that these countries can afford investing

in some preventive measures, if they cannot get the necessary funds. Moreover, it is now obvious why the Eastern Europe countries (O-Annex-I) supported the flexibility mechanisms during the negotiations in Kyoto. It can be said, then, that this scheme especially benefits developed countries, which can continue polluting, and marginally benefits some developing countries such as China, India, or Eastern Europe.

*Ecological egalitarian scenario:* Under the assumptions defined before, we can see in table 3 major changes compared to the Kyoto scenario. First, because of the stringent ecological conditions (0.37 tC per capita) all regions but India should pay for the excessive emissions. In this case, only India would receive some money derived to their underuse of the resource. Concretely, the amount would be 2869.01 M\$ or 0.90% of the GDP. China would pay the equivalent to 1.18 % of GDP, O-Annex-I 2.42%, but the USA 0.52%, O-OECD 0.24% and RW 0.33%. In this case, the money should go to a common fund in order to finance some adaptation projects in the most threatened countries (like in the case of Agarwal & Narain) until the emissions are below the ecological threshold. In this case the system is giving signals to all countries to reduce or not increase emissions. The order of the numbers involved might seem huge, but it is not so when compared with the ‘debt service’ that some countries are facing. Thus, as we can see in table 1, India is facing a service that is 2.59% of the GDP (in 1990), and the rest of the world 4.48%. In this situation, the 0.52% for the USA or the 0.24% for O-OECD seems quite affordable.

It might also seem paradoxical that the rest of the world has to pay 0.33% of GDP, but this is because in 1990 the average emissions for the region were 0.56 tC, above the ecological limit. This number, however, reflex internal discrepancies. Thus, Singapore would have a similar behaviour to the OECD, as they should pay 0.77% of the GDP, but Rwanda would get 2.37% or Peru 0.24%. This is one of the problems of aggregation of data, we loose relevant information.

*Parikh’s egalitarian scheme:* under this scheme, in which we take into account per capita emissions in 1990 (1.13 tC), we find that all Annex-I countries have to pay to those non-Annex-I countries, because the later are under the average emissions. In absolute terms the most benefited are RW (23992.43 M\$), then India (15556.22) and China (13415.48). In relative terms, however, the distribution changes and is India the most benefited with 4.89 % of GDP, China follows with 4.15%, and then RW with a little 1.07%. When taking into account the payments to be made by developed countries, we realise again that, in relative terms, are affordable. Thus, in the case of the USA is 0.44% of the GDP (in 1990), with 0.17% for O-OECD and 1.85% for O-Annex-I. Even in this later case, where the costs are huge, they seem affordable if compare them with the debt service that some developing countries were facing in 1990 (as seen in table 1).

These amounts of money would be very important for developing countries. For example, in the case of India, these revenues would be double than the debt service. This is almost the case for China, and RW would cut debt service in 25%. Again, in the case of RW, some discrepancies arise within among countries. Thus, Singapore would pay 0.60% of GDP, but Peru would get 1.93% (debt service in 1990 was 2.50%), and Rwanda 7.19%, more than compensating a debt service of 1.00% of GDP. Overall, for RW, even with this scheme, the revenues are not huge, but significant especially for some countries, the poorest ones, the most affected by ‘external debt’.

Something else to be mentioned is the non-relevant difference between the two egalitarian schemes for developed countries. Indeed, in relative terms they have to pay similar percentages in both schemes, and definitely those percentages are affordable for those over developed economies. There is no technical or practical reason against these money transfers if we compare them with the transfers from the South to the North in the form of debt service.

#### Ecological Debt:

Under the umbrella of the Jubilee 2000 (a movement of NGOs, Churches, etc. that looks for the cancellation of the External Debt for developing countries by the end of year 2000), some people are claiming the 'ecological debt' that the North owes to the South. Last July, 200 groups (NGOs) from 55 countries endorsed a declaration asking the World Bank both to change the policy of credits taking into account environmental criteria and to recognise the 'ecological debt'<sup>35</sup>.

One of the factors that explain the debt is the uneven use of the CO<sub>2</sub> sinks by different countries (Parikh 1995; Martínez-Alier 1998, 2000; Christian Aid 1999). But, what is 'ecological debt'? Following Martínez-Alier (1998), the ecological debt would be formed by both exports undervalued (since the price does not include the environmental costs involved in their production-transportation) and environmental services provided free. More specifically, when trying to express it in monetary terms, he says that, regarding ecologically unequal trade<sup>36</sup>, the components would be:

- The costs of reproduction, or maintenance, or sustainable management, of the exported renewable natural resources.
- The actualised costs of the future lack of availability of destroyed natural resources.
- The costs of reclamation of the local damage produced by exports, or when no reclamation is possible, the actualised value of the damage.

Regarding the lack of payment of environmental services:

- The costs of reclamation of the impacts caused by importing solid or liquid toxic wastes.
- The value of the gaseous residues absorbed without cost in the atmosphere up until the present (mainly CO<sub>2</sub>), supposing equal rights to the world's carbon sinks.
- The value of the information and knowledge on genetic resources given freely, when commercial use has been made of it.

Our calculations, thus, are only part of a bigger debt that accounts also for other kind of services like nutrient recycling, soil formation, evaporation of water, purification in wetlands, etc. All these services should be of equal access for every human being. This fact makes our calculations more relevant, because, as we have seen for the two egalitarian schemes, the resources generated are similar to the debt service in general, meaning that when including the rest of the services it is probably that would compensate the debt service. It is true that an exact quantification of the ecological

<sup>35</sup> Environmental Media Service, 13<sup>th</sup> of July 2000. <http://www.ems.org/banks/platform.htm>

<sup>36</sup> Ecologically unequal trade has two causes. First, environmental externalities are not included in export prices. Second, the time required to produce the goods exported from the South is frequently longer than the time required to produce the imported manufactured goods and services (Martínez-Alier 1998).

debt is impossible, but this is not our goal. Rather, what I pretend is just to show the ecological debt as a counterweight to the external debt (Martínez-Alier 1998), in order to ask for the cancellation of the former. Why? Because in contrast to real wealth, which is subject to the laws of physics, money debt (or financial wealth) does not decay entropically with time, but grows according to the interest rate. Indeed, it grows faster than renewable resources do, implying that in order to pay the debt, those countries have to destroy their environment (de-capitalise in economic terms). This is why if it were possible to achieve the cancellation of the External Debt on account of the ecological debt, this could diminish the pressure on natural resources, at the same time as improving the situation of the poor (idem).

Only as a term of comparison, Martínez-Alier (2000) remind us that the external debt of Latin America in 1999 was of 700 billion dollars that could be offset by the Northern accumulated ecological debt regarding CO<sub>2</sub> in the last years. Indeed, the ecological debt that we have found here, in Parikh's egalitarian scheme, is of 52964.13 M\$ in year 1990 (45.30% for RW, 29.37% for India, and 25.33% for China). In 1990, external debt of non-Annex-I countries was 1114021.9 M\$, meaning that could be cancel in about 21 years. This is the kind of argument I was looking for. When taking into account one of the components of the ecological debt, we find numbers that can be compared to the 'debt service'. This is the basis for asking for the cancellation of the External debt for developing countries.

In conclusion, as Martínez-Alier (2000) says, "the claim of the ecological debt from the South, should it become an important topic in the international political agenda, would contribute powerfully to the "ecological adjustment" which the North must make".

### Conclusion

In this brief essay regarding equity in the CO<sub>2</sub> emission rights, I have shown a few things. First, I have supported the idea that an egalitarian allocation of emission rights is fairer than the present system. I have shown that the egalitarian scheme (in the two ways analysed here) implements the idea of parity. Indeed, it is fairer because it generates more resources for those less developed countries (the ones that use less energy, and then generate less CO<sub>2</sub>).

I have shown, as well, that this claim for equity is actually present in the Framework Convention on Climate Change (UN 1992). And I have just generated numbers for one way of implementing it.

I have also defended this political way of generating scientific knowledge on the basis that environmental problems are one example of complex problems that complex system face. In this new context, the normal science looking for truth has no room. Rather, a post-normal science is needed, in which the relevant is not the final result but the process of knowledge generation and decision making. Thus, we have to guarantee the quality of the process by having all stakeholders involved in the process. This would mean that the different value judgements behind all positions should be made explicit. This, in the context of climate change, requires the involvement of all countries in decision making, but this is only possible if equity considerations are taken into account. Equity becomes, then, a practical necessity. It is needed to achieve the political acceptability of the decisions taken. So, apart from the philosophical

considerations (every human being should have an equal share of the environmental services), we take also into account practical ones when defending the idea of equity.

I have said, as well, that we are interested in distributive justice (environmental justice as defined before) because is the relevant from an environmental point of view. Moreover, I have given some numbers to show that the Kyoto scenario is not fair, and implies rewarding past polluters, and the repetition of the uneven distribution of emissions among countries. It fails, as well, in dealing with the environmental problem. Since the Convention asks for non-interference with the climate system (something that can be understood under the logic of strong sustainability), and the Kyoto system is not going to deal with it, I have proposed the 'ecological egalitarian scenario'. But because this is very radical in the reductions required, I have introduced, as well, another less stringent egalitarian scenario in which the level of the reductions would be agreed among the stakeholders. Using the last scenario, after introducing the theoretical concept, I have generated some data on an 'ecological debt' that the North owes to the South, 52964.13 M\$ in 1990, reflecting only the overuse of the environmental service carbon absorption.

However, when dealing with the viability of these scenarios, we have to notice that even in the 'ecological egalitarian scenario', if all the payments involved were paid only by developed countries (excluding Eastern Europe) this would be only 0.57% of GDP (81639.91 M\$). That is, it is true that is a huge amount of money, but it should be affordable, especially if we compare it with the 'debt service' that some developing countries are facing (see table 1). In case developed countries are not willing to pay for economic reasons, this would lead us to the corollary of this dissertation: *the cancellation of the External Debt of developing countries is something needed and just*, since is deviating huge resources from developing countries that could be used in a better way for sustainable development.

## VII. ACKNOWLEDGEMENTS

I am in debt with Joan Martínez-Alier for inspiration on the topic. I am also in debt with Tiziano Gomiero, with who I discussed a similar approach to that used by Christian Aid. Thanks both to Andrew Dobson for introducing me the topic of Environmental Politics and Matthew Paterson for doing the same with International Relations, and for giving me, as my supervisor, helpful comments that improved considerably this dissertation. Naturally, none of the above are responsible for the views expressed or for any remaining errors. A scholarship from Caja de Ahorros del Mediterraneo (CAM) and The British Council has funded my studies in Keele University.

## VIII. BIBLIOGRAPHY

- Agarwal, A. y S. Narain (1991). Global Warming in an Unequal World. A Case of Environmental Colonialism. Centre for Science and Environment, New Delhi, India.
- Alcamo, J. & Kreileman, E. (1996): "Emission scenarios and global climate protection", Global Environmental Change, Vol. 6, number 4.
- Azar, C. (1998). "Are optimal CO<sub>2</sub> emissions really optimal?". Environmental and Resources Economics, 11 (3-4).
- Azar, C. & T. Sterner (1996). "Discounting and distributional considerations in the context of global warming". Ecological Economics, 19.
- Banuri, T.; Göran-Mäler, K.; Grubb, M.; Jacobson, H.K.; Yamin, F.(1996): "Equity and social considerations", in Bruce et al. (1996).
- Beitz, C.R. (1985): "Justice and International Relations", in C. Beitz; M. Cohen; T. Scanlon; and A.J. Simmons (eds.): International Ethics. A Philosophy & Public Affairs Reader. Princeton University Press, Princeton, New Jersey.
- Brown, P.G. (1997). "Stewardship of Climate", Climatic Change, 37.
- Bruce, J.P.; Lee, H.; Haites, E.F. (eds.)(1996): Climate Change 1995. Economic and Social Dimensions of Climate Change. Contribution of Working Group III to the Second Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.
- Cabeza, Maite (1996). "The concept of weak sustainability", Ecological Economics. Vol. 17, nº3
- Christian Aid (1999): Who owns who. Climate change, debt, equity and survival. Downloadable at <http://www.christian-aid.org.uk>
- Cline, W.R. (1992). The Economics of Global Warming. Institute for International Economics, Washington DC.
- Commission of the European Community (CEC) (2000): Green paper on greenhouse gas emissions trading within the EU. Com(2000)87, downloadable in [http://europa.eu.int/comm/environment/docum/0087\\_en.pdf](http://europa.eu.int/comm/environment/docum/0087_en.pdf)
- Estrada-Oyuela, R.A. (2000): Climate Change Mitigation and Equity. IPCC 2<sup>nd</sup> Regional Experts' Meeting on "Development, Equity and Sustainability". Havana, Cuba, 23-25 February 2000.
- European Union (1999): Community strategy on climate change: Council Conclusions. No. 8346/99, 18 May. Brussels.
- Fermann, G. (1997): "Political context of climate change", in G. Fermann (Ed.): International Politics of Climate Change. Scandinavian University Press: Oslo.
- Funtowicz, S.O. y J. Ravetz (1991). "A New Scientific Methodology for Global Environmental Issues", in Costanza, R. (editor): Ecological Economics: The Science and Management of Sustainability, Columbia University Press, New York.
- Giampietro, M (1997). "Linking Technology, Natural Resources, and the Socioeconomic Structure of Human Society". Advances in Human Ecology. Vol. 6.
- Grubb, M.; Sebenius, J.; Magalhaes, A.; Subak, S. (1992): "Sharing the burden", in I.M. Mintzer (Ed.): Confronting Climate Change. Stockholm Environment Institute. Cambridge University Press: Cambridge.
- Grubb, M.; Vrolijk, C.; Brack, D. (1999): the Kyoto protocol. A Guide and Assessment. Royal Institute of International Affairs and Earthscan Publications, Ltd. London.
- Gupta, S.; Bhandari, P.M. (1999): "An effective allocation criterion for CO<sub>2</sub> emissions", Energy Policy 27: 727-736.

- Hare, B. (1998). Fossil fuels and climate protection: the carbon logic. Greenpeace International. Amsterdam.
- Houghton, J.T. et al. (eds) (1990). Climate Change: The IPCC Scientific Assessment. Report from Working Group I, CUP, Cambridge University Press, New York.
- Houghton, J.T. et al. (eds) (1992). Climate Change 1992: The Supplementary Report to the IPCC Scientific Assessment, Cambridge University Press, New York.
- Houghton, J.T. et al. (eds) (1996). Climate Change 1995. The Science of Climate Change. Cambridge University Press, New York.
- Hyder, T.O. (1992): "The climate negotiations: The North/South perspective", in I.M. Mintzer (Ed.): Confronting Climate Change. Stockholm Environment Institute. Cambridge University Press: Cambridge.
- IISD (1999): "Summary of the fifth conference of the parties to the United Nations Framework Convention on Climate Change: 25 October- 5 November 1997", Vol. 12, num. 123.
- Kopolo, G. (1999): Surrogate emissions. Could this be a new twist to the carbon-trading debate? MSc Thesis, Environmental Change Unit, University of Oxford.
- Levy, D.L. & D. Egan (1998): "Capital contests: national and transnational channels of corporate influence on the climate change negotiations", Politics & Society, Vol. 26, Issue 3.
- Luper-Foy, S. (1992): "Justice and Natural Resources", Environmental Values, Vol.1 (1).
- Martínez-Alier, J. (1998): Ecological Debt-External Debt, downloadable at <http://cosmovisiones.com/DeudaEcologica/index.html>
- Martínez-Alier, J. (2000): Environmental Justice, Sustainability and Valuation. Harvard Seminar on Environmental Values, Tuesday, March 21, 2000. Downloadable at <http://www.ecoethics.net/hsev/200003txt.htm>
- Mielnik, O. & Goldemberg, J. (1999): "The evolution of the 'carbonization index' in developing countries", Energy Policy 27: 307-308.
- Mills et al. (1991). "Getting Started: No-regrets Strategies for Reducing Greenhouse Gas Emissions", Energy Policy, July/August.
- Moltke, K. & A Rahman (1996): "External perspectives on climate change", in T. O'Riordan & J. Jäger (Eds.): Politics of Climate Change. A European Perspective. Routledge, London.
- Noël, J.F. & M. O'Connor (1998). "Strong Sustainability and Critical Natural Capital", in S. Faucheux and M. O'Connor (eds.) (1998). Valuation for Sustainable Development. Methods and Policy Indicators. Edward Elgar, Cheltenham, UK.
- Nordhaus, W.D. (1991 a). "A Sketch of the Economics of the Greenhouse Effect", American Economic Review, Papers and Proceedings, 81(2).
- Nordhaus, W.D. (1991 b). "To Slow or not to Slow: the Economics of the Greenhouse Effect", Economic Journal, 101(407).
- Nordhaus, W.D. (1994). "Expert Opinion on Climate Change", American Scientist, January-February.
- Norgaard, R.B. & R.B. Howarth (1991). "Sustainability and discounting the future", in Costanza, R. (de): Ecological Economics: The science and management of sustainability. Columbia University Press, New York.
- Oberthür, S. & H.E. Ott (1999): The Kyoto Protocol. International Climate Policy for the 21<sup>st</sup> Century. Springer-Verlag, Berlin.
- Page, E. (1999): "Intergenerational justice and climate change", Political Studies, XLVII, 53-66.

- Parikh, J.K.(1995). "Joint Implementation and North-South Cooperation for Climate Change", International Environmental Affairs, Vol. 7(1).
- Paterson, M. (1993): "The Politics of Climate Change after UNCED", Environmental Politics, Vol. 2 (4).
- Paterson, M. (1996): Global Warming and Global Politics. Routledge: London.
- Ramos-Martín, J. (1998): "CO<sub>2</sub> Emissions Reductions Costs Models". Mimeo, in Spanish.
- Ramos-Martin, J. (1999): "New Role of Kyoto Mechanisms to Improve Equity under a New Burden Sharing Scheme", Joint Implementation Quarterly, Vol.5, number 4.
- Ramsey, F.P. (1928). "A mathematical theory of saving". Economic Journal. 138.
- Rijsberman, F.J. and R.J. Swart (eds.) (1990): Targets and Indicators of Climate Change, Stockholm Environment Institute.
- Rose, A.; Stevens, B.; Edmonds, J.; Wise, M. (1998): "International Equity and Differentiation in Global Warming Policy", Environmental and Resource Economics, 12: 25-51.
- Rowlands, I.H. (1995): The Politics of Global Atmospheric Change. Manchester University Press, Manchester.
- Shue, H. (1994): "After you: May Action by the Rich be Contingent on Action by the Poor?" Indiana Journal of Global Legal Studies, Vol.1 (2).
- Simon, H.A. (1983): Reason in Human Affairs. Stanford University Publications, Stanford, CT.
- Solow, R. (1992). "An almost partial step towards sustainability". An invited lecture on the occasion of the fortieth anniversary of Resources for the Future. Washington, DC, 8 October. Citado en Azar & Sterner.
- Spash, C.L. & R.C. d'Arge (1989). "The greenhouse effect and international transfers". Energy Policy, 17.
- Stanners, D. & P. Burden (eds.) (1995). Europe's Environment. The Dobbris Assessment. European Environmental Agency, Copenhagen.
- UN (1992): "Convention on Climate Change", The Earth Summit, United Nations Commission on Environment and Development, Rio de Janeiro, June 1992.
- UNFCCC (1995). "Activities Implemented Jointly", Decision 5/CP.1. Report of the Conference of the Parties on its First Session, held at Berlin from 28 march to 7 april 1995. Addendum, Part Two: Action taken by the Conference of the Parties at its Fourth Session. FCCC/CP/1995/7/Add.1.
- UNFCCC (1997). Kyoto Protocol to the United Nations Framework Convention on Climate Change. FCCC/CP/1997/L.7/Add.1, disponible en <http://www.unfccc.de>.
- UNFCCC (1998). "The Buenos Aires Plan of Action", Decision 1/CP.4. Report of the Conference of the Parties on its Fourth Session, held at Buenos Aires from 2 to 14 november 1998. Addendum, Part Two: Action taken by the Conference of the Parties at its Fourth Session. (FCCC/CP/1998/L.6/Add.1).
- Ward, H. (1996): "Game theory and the politics of global warming: the state of play and beyond", Political Studies, XLIV, 850-871.
- Watson, R.T. et al. (1997). The impacts of climate change: An assessment of vulnerability. Special Report of IPCC Working Group II for the IPCC. November.
- Wenz, P.S. (1988): Environmental Justice. State University of New York Press: New York.
- Wilson, E.O. (1993): The Diversity of Life. The Penguin Press
- WRI (World Resources Institute)(1990): World Resources 1990-1991, Oxford University press, New York.
- World Resources Institute (1999): World Resources Database 1998-1999.

- Young, O. (1989a): “The politics of international regime formation: managing natural resources and the environment”. International Organization. 43: 349-75.
- Young, O. (1989b): International Cooperation: Building Regimes for Natural Resources and the Environment. Ithaca NY: Cornell University Press.
- Zayalova, L.; Michaelowa, A. (2000): “Should non-Annex I Countries Accept Voluntary Targets?”, Joint Implementation Quarterly, Vol. 6 (1).
- Zhang, Z. (2000): “Estimating the size of the potential market for the Kyoto flexibility mechanisms”, Proceedings of the 3<sup>rd</sup> Biannual Conference of the ESEE, May 3 to 6 2000, Vienna.