Helping Operationalise article Two (HOT):

Report of Phase 1 of a science-based-policy dialogue on fair and effective ways to avoid dangerous interference with the climate system and implications for Post-Kyoto policies.

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Executive Summary

The problem

Climate change presents the global community with what has been called an "unstructured" problem, that is, a large scale, highly complex problem containing many uncertainties and cross-cutting issues. Science can only make educated guesses as to what the effects of the problem will be and there is little agreement among and within countries as to how, and to what extent, climate change should be addressed. It is especially difficult to reach negotiated solutions to such problems, partly because of the shear range of issues and unknowns involved, but also because difficult to assess and little discussed value questions are prominent. Thus, while science may be able to offer its "best guess" scenarios as to what the effects of climate change will be, this in itself is insufficient because it does not answer questions such as: To what extent are people willing to accept a changed environment? What are the sacrifices and trade-offs that are acceptable in dealing with the climate change problem? Yet it is these types of questions that form the basis of any negotiation in the area of climate change. Furthermore, while science *cannot* answer these questions, the formal negotiation process simply *does not* discuss broad value issues. The pressures and structure of the formal negotiation setting tends to focus negotiators on problems that are readily solvable or easy to debate. The result is that only short-term issues and details are discussed while the wider context and consequences of climate change are forgotten This is evident in the fact that negotiations have largely avoided Article 2 of the Framework Convention on Climate Change (FCCC) which states the long-term objectives of the climate change regime.

This project addressed Phase 1 of a three-phase programme entitled: 'Helping Operationalise article Two (HOT): A science-based policy dialogue on fair and effective ways to avoid dangerous interference with the climate system and implications for Post-Kyoto policies'. The aim of this programme is to elaborate on Article 2 of the Climate Change Convention (FCCC), which provides the long-term objective of the climate change regime. This is seen as an important step towards ensuring that the consecutive short-term steps adopted in the regime meet the long-term objective.

Article 2 is not an issue that can be addressed by scientists alone, and calls for a science-based policy dialogue. A dialogue is a time consuming process and to ensure that it is successful it is vital that the participants are committed to the process in terms of the issues involved, the time they are willing to spend on the project and the need to engage seriously in a dialogue as opposed to a monologue or negotiation. This calls for an intensive investment in the conditions that guarantee that such a project will be successful. Hence, the first phase of this project is essentially the preparatory phase which aims at putting in place the conditions that will ensure the international multicultural dialogue to be engaged in Phase 2 is effective.

The second phase is the continuation of the dialogue process at regional and global levels aimed at producing a document that articulates and elaborates on the different interpretations of Article 2 and the reasoning that justifies these interpretations. This is depicted in the following figure.

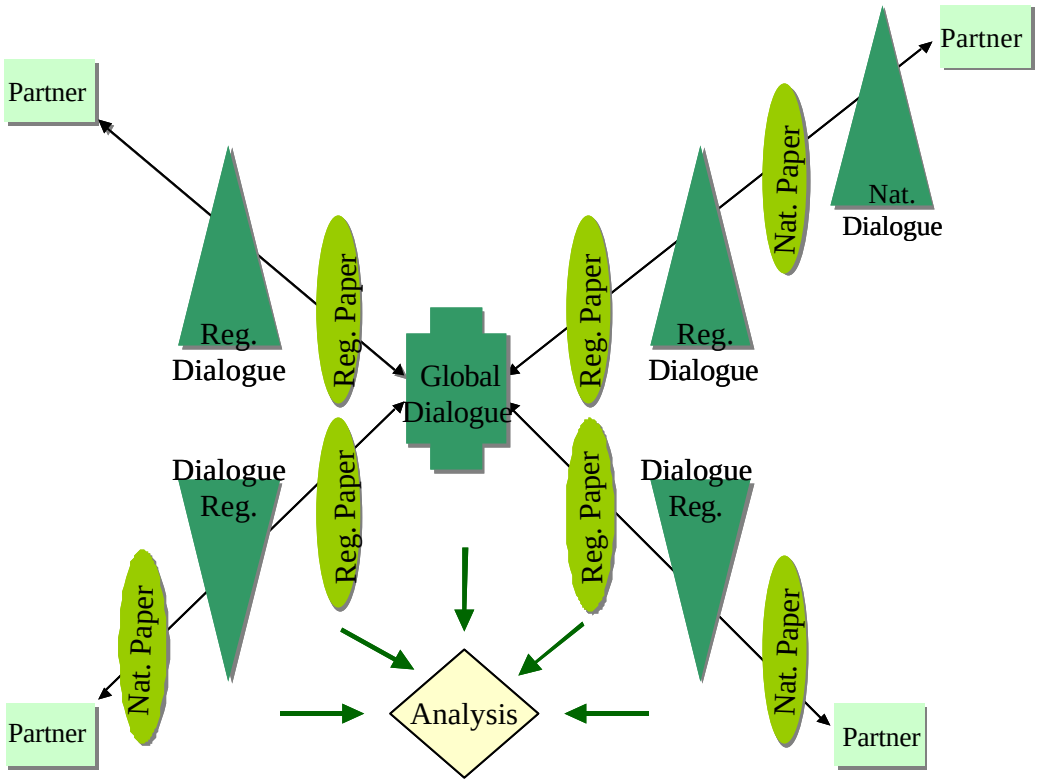


Figure 1 The interactional set of dialogues in the HOT Programme

The project was implemented by six institutes spread throughout the world. These included the Institute for Environmental Studies (IVM) in Amsterdam, the National Institute for Public Health and the Environment (RIVM) in the Netherlands, The Energy and Resources Institute (TERI) in Delhi, ENDA-Tiers Monde in Dakar, the Tyndall Centre for Climate Research in the UK, and COPPE/Climate Centre in Brazil.

Phase 1of this programme, the preparatory phase, was aimed at investigating whether the conditions are ripe for engaging in an international multicultural dialogue. Is there support for conducting an experiment on an interacting series of dialogues as a means to address complex global problems? Phase 1 focused on the inventorisation and preliminary discussion of these issues at national and/or regional level, as well as some initial experimentation with the rules of procedure for developing such a dialogue.

The research question for Phase 1 was: Given the vast differences in the national interests of countries, how can a common basis be developed for the further articulation of Article 2 of the FCCC?

Four national and / or regional dialogues were carried out in Asia, Africa, Latin America and Annex I countries. The purpose of the dialogues was not to change the participants' negotiating positions however. Dialogue success rather, was defined as a situation in which participants from different groups listened openly to each other, felt that they were truly listened to, were fully involved in the discussion, and were given a chance to reflect on their own position without compromising their core values. The point is that the dialogues are not related to political negotiations. The overall aim of the exercise was to in-

crease understanding and explore new areas of agreement by providing a neutral and open environment – not to directly impact the ongoing climate negotiations.

Prior to the dialogues, questionnaires were distributed in different parts of the world to guage the responses of the stakeholders. The Brazilian project team sent out 700 questionnaires but received only 13 answers. The Asian survey was sent to 200 stakeholders and 27 responses were elicited. 14 responses were from South Asia, 10 from South-East Asia, 2 from the former Soviet Union countries and 1 from West Asia. Classified in terms of stakeholders, 6 responses were received from government, 8 from scientists, 10 from NGOs, 2 from international organizations and 1 from business. The African survey was sent to about 100 respondents and 20 responses were received, most of which were from NGOs and research centres and 8 from policy makers and negotiators, some from IPCC scientists. In terms of geographical representation half of the responses were from West Africa. The Annex I questionnaire was sent to 300 stakeholders of whom 38 responded. The responses were mostly from scientists (17), policymakers (15), NGOs (5) and business (1). Most responses came from Europe (19), America (8), other OECD (7), Central Europe (1) and International Organisations (3). However, there was a relatively low response to these questionnaires.

When consulted, they explained that they only respond when they are somehow stimulated by the subject and feel that their opinion counts. However, it appears that in many of the regions people were afraid to respond because they did not have a good understanding of the climate change issues and had actually never given much thought to Article 2, even though they were engaged in the climate change discussions in one way or another. A request to simplify the questionnaire as a means to gauge responses was made.

Four workshops were held in different parts of the world as shown in the table below.

	TERI	ENDA	COPPE	OECD
Date regional meeting	30 June, 1 July.	27 – 28 June	14 May	2-3 June
Venue regional meeting	Bangalore	Accra	Rio de Janeiro	Amsterdam
Procedural chair	Kok Kee Chow (Malaysia) or Shekhar Dasgupta (India)	Dr. Papa Cham (Gambia) and Dr. Peter Yerima Tarfa (Nigeria)	Dr. Fabio Feldmann	Dr. Joyeeta Gupta
Substantive chair	Mohan Munasinghe (Sri Lanka) or Tsuneyuki Morita (Japan)	Jean Philipe Thomas	Dr. Fabio Feldmann (with technical support COPPE)	Dr. Bert Metz
Logistical coordinator	Poonam Sahai and Tanushree Sinha	Djimingue Nanasta	André Simões and Carolina Dubeux	Marcel Berk en Wietske van den Bovenkamp

At the dialogues themselves, it also became increasingly apparent that most of the participants neither had a clear-cut position on Article 2 based on reasoned arguments, de-

tailed estimates of indicators, nor perceptions of threshold values. Instead they were still at the stage of calling for more information in order to be able to make an informed position. Although we initially did intend to cluster the different views, we discovered that in most cases it made more sense to inventorize the informational needs emerging from the different perspectives. It is anticipated that dealing with these informational needs will help to provide a common starting point for developing different positions.

Major conclusions

At the end of the first phase of the HOT project, the project team concluded that they were satisfied with the outcomes of the first phase. Most participants in the process became very stimulated by the complicated scientific and value dimension of Article 2 and the need to develop new instruments for communication at a global level on these complex issues. Some of the key conclusions of the first phase are:

The focus on Article 2

There was general consensus on the need to focus on Article 2. It was agreed that political agreement was possible in 1992 by keeping Article 2 unclear and open to interpretation; but any future steps will need a further articulation of this Article. This leads to the implication that any attempt at articulating Article 2 will be an extremely politically challenging task and that high quality regional preparation and global dialogue as a precondition for negotiation are a must.

Is climate change a serious problem?

In all the developing country workshops, there appeared to be some doubts as to the severity of the potential impacts of climate change for the worlds'developing countries and there was a strong request for scientific studies that would help predict the magnitude of the impact and its consequences. This was somewhat in sharp contrast with the Annex I workshop where there was little doubt that developing countries would be very hard hit. The developed country questionnaires revealed that many felt that we were already experiencing dangerous climate change. The impacts on developing countries were seen to be primarily in relation to small island countries and possibly desert regions, but the implications for the hydrological systems worldwide appeared to be underestimated.

Can environment and development be dichotomised?

Many stakeholders in the developing countries feel that these countries should focus on development and the environmental issues are of lesser importance. Besides, given the current status of the problem, the magnitude of the costs to reduce the concentration of GHG in the atmosphere to a safe level and the political difficulties to implement the required measures, there will be need to count on technology in order to minimize the problem. The argument was that new technologies will substitute for some the functions of the environment. This leads to the question: Can developing countries afford to dichotomise ecosystem protection and development in the context of Article 2? Further, can new technologies actually imply a reduced dependence on the environment? How can climate change be mainstreamed?

The adequacy of Article 2

The discussions concluded that Article 2 needed to be further elaborated so that there is common understanding of:

- What is not an acceptable outcome of Article 2;
- When Article 2 conditions are no longer met;
- Common starting points for discussion and elaboration on the key terms in the Article and the appropriate scale for these terms;
- Identifying information needs to help the articulation process.

Naming the Controversies

There was some divergence about how serious climate change is as a problem, how "dangerous" should be defined, how priorities should be set, the risk of reductionist interpretations of Article 2 and that the fear that historic responsibilities would not be taken into account.

There was also fear about the monetization of social and cultural aspects and the excessive use of economic instruments.

There were concerns that the way ecosystems were included it was unclear if all ecosystems should be protected for themselves and whether the ecological services they provide to humans was included. There was general consensus on, in any case, including the latter concept in the articulation of this concept. Maintaining all ecosystems may be a valuable goal but not feasible.

The first step in dealing with the controversies is to name them and to see if we can develop a common conceptual document in relation to these controversies and then move the dialogue further from there.

Unacceptable outcomes

The stakeholders indicated that three types of outcomes that are considered as unacceptable to the developing countries:

- adverse environmental outcomes such as increase in famines, natural disasters, disturbances to global/regional climate patterns, depopulation of small islands and the rise of environmental refugees and the relegation of adaptation as a secondary issue;
- adverse policy outcomes for developing countries such as binding commitments that compromise the right to development, economically unfeasible implementation time frames, inequitable distribution of costs, inappropriate technology transfer, and other negative impacts on the domestic economy, etc. and
- adverse policy outcomes for all countries which would allow unsustainable energy use, unplanned industrialization and fuel-wood consumption, excessively high per capita emissions, high carbon intensity of GDP.

Finding common ground through local impacts

The participants asked for information regarding how concentrations of GHGs affect ecosystems, how they impact on local human health and timber production, how they affect desertification; what the roles of oceans, soils and deserts are as sinks of greenhouse

gases; how much of the emissions are human induced; the development of indices of local and regional vulnerability and adaptive capacity, various response measures for adaptation, methods to determine thresholds for risks, and approaches to assess risks in a holistic manner. However, if it is possible to identify local systems that will be harmed in different types of countries both rich and poor at the same concentration level, this same analysis of local perspectives may generate common ground between countries.

Finding common ground through the development of Indicators

There was general consensus that developing indicators for what could be dangerous is a useful way forward. There was also a need to create a procedure for defining indicators. Furthermore it was necessary at this stage to prioritise the indicators on the basis of a set of criteria. It was also considered useful to know what each concentration level would imply in terms of impacts at the global and regional level.

Finding common ground through understanding the importance of values and principles in international law and relations

The major question that was raised in all the dialogues was how mitigation and adaptation costs should be distributed among countries and what criteria should be used to do this. Several criteria were mentioned in the different dialogues and number of principles were put forward. The legal viability of these norms needs to be verified through legal and political science research.

Social and scientific learning

Most of the participants in the developing country workshops had a very little notion of what a discussion of Article 2 would involve. Many felt intimidated by the questions in the questionnaire and were afraid that they did not have enough knowledge to deal with them. However, by the end of the workshops, most felt that even if they had not changed their position, they had learnt considerably about the various dimensions of Article 2. But even in the OECD workshops, participants felt that they had been exposed to a rich learning experience.

Self-selection of participants

In all the regional workshops it has become more than apparent that some kinds of stakeholders are more willing to participate than others. Very few participants from business and industry responded positively to the invitations to participate. This indicates that either they do not see the determination of long-term goals as something they have any competence in, or simply because of lack of interest. This also implied that only those who were either very interested or motivated in the issue participated. The question is: Is it a structural weakness of the approach that the groups turn out to be groups of like-minded people? On the other hand, there were enough differences of opinion in all the workshops to still make it worthwhile to continue the discussions. Yet, this is a structural weakness and the partners will have to devise ways to include uninterested stakeholders with large stakes to join the process on the basis of the idea that "you have to start somewhere". The dialogue will hopefully provide ideas and learning that, eventually, will influence the many parties who are not interested or are perhaps even hostile to

climate change negotiations. This in itself is a good justification to continue the dialogue cycle further since the more chance people have to gain and share information, the more likely it is that ideas will sink in and extend to a wider circle.

Recommendations

The major recommendations that flow out of this research are:

Continuation of the dialogues

There was general consensus on the need for national and regional workshops to help participants prepare for global workshops on this issue. The developing country participants felt especially uncomfortable about discussing an issue on which they had not given any thought to. Many now feel that they have a much better idea of what the key issues are and they will be in a better position to enter into discussions at a global level, before reflecting again in regional groups. The dialogue, unlike a workshop, gave the participants an opportunity to focus on what they understand from the issues, to identify the sort of information they need, and to articulate their underlying values.

Provide assessments of impacts at regional level

Much more detailed information should be made available to the developing country respondents not so much on the effects on small island states, since this appears to be internalized, but on general environment and ecosystems of the larger countries in the world and how this can affect their economy. For example, according to an expert stabilization at 370 pp, would already intensify El Niño and lead to severe consequences for Latin America; something not reflected in the IPCC TAR reports.

Initial information needs

The following section is based on an analysis of the information needs arising from the questionnaires, the workshop discussions both directly and indirectly.

The information needs can be classified into four categories:

- Information needs on impacts
    - Anthropogenic contribution to climate change;
    - Information on the correlation between GHG concentration levels and El Niño;
    - Information on the relationship between development, food production and ecological resilience;
    - Information needs on regional and local health impacts;
    - Regional impacts on ecosystems, their vulnerability and their capacity to adapt;
    - How can non-monetary indicators be developed, scientifically justified and defended in the international arena?;
    - Can a poverty mainstreaming approach be beneficial in interpreting Article 2?
- Information needs on new technologies

    - Can genetic engineering provide a solution to food shortage and how will this affect developing countries?

- Information needs on articulation of certain terms
    - Sustainable development;
    - Ecosystems to adapt naturally;
- Development of models
    - Development of indicators and threshold levels; building on the ideas that emerged at the workshops;
    - Policy guidelines on how the information should be communicated to non-scientists;
    - Policy guidelines on how to deal with scientific uncertainty and how to articulate the precautionary principle;
    - Policy guideline on a process to develop indicators;
    - Development of indicators on sustainable development (link up with the South-South-North project on this subject).

Need for value related research

There was considerable discussion on the conflicts in values between countries and the role of values in international relations and law. There was dissatisfaction with the notion that national interests alone determine how countries take responsibility for their actions. In many of the workshops, it was emphasized by some of the participants that equity principles in Article 3 should determine the way Article 2 is interpreted. This calls for more value related research in international law and politics.

Procedural aspects

- During the process some parties realised that they had common grounds with others which they had not previously identified especially in relation to the relationship between climate change, commerce and security, and adaptation.
- It was decided to continue with the pre-dialogue questionnaire process because this helped to involve and inform a larger group of social actors about the problem and to gain access to their views. However, in the following round, the questionnaire will be simplified and possibly include closed questions based on the information received.
- It was also felt necessary to find ways to make the process more attractive to other parties such as industry and policy makers from different sectors so that they would also be willing to engage in the discussion and bring their perceptions to the discussion.
- Since in some of the workshops, people were torn between what they saw as fair and what they saw as negotiable and reasonable, possibly in the future rounds of the dialogue we should try and split the two notions and see if that yields ground for more cooperation.

Conclusion and Initial follow-up steps

Overall, the HOT programme decided that it is worthwhile to continue with the iterative dialogue process because participants did feel that they were given a chance to focus on their understanding of the issues, identify the gaps in their knowledge, and articulate their underlying values in relation to Article 2. The dialogues showed promise as an important means to communicate and learn from people and so create a basis for dealing with complex environmental problems such as climate change. Given that values and norms take a long time to crystallize and that Phase 1 is but a first step in the dialogue process, it is too soon make any conclusions about the broader significance of the dialogues and what their effect on the norms surrounding Article 2 might be. Article 2's definition of the ultimate goal of the climate change regime as the prevention of "dangerous anthropogenic interference with the climate system" leaves many issues open to interpretation. Science is incapable of clarifying these issues because they are essentially based on judgment and values. The world must decide at what point it considers the costs of mitigation to outweigh the costs of adaptation - but there are many different views as to what the acceptable trade-offs are. It is clear however, that since these norms and trade-offs are the basis of international environmental problem solving, more research needs to be conducted into the role of values and norms in this context.

As an initial follow-up step, the HOT programme team submitted a pre-proposal to MISTRA in Sweden and was short-listed for submitting a proposal. This proposal has been submitted to MISTRA and we are now awaiting the outcomes of that discussion.

Another follow-up proposal has been submitted by some members of the HOT programme to the Dutch NRP programme to undertake a dialogue within the Netherlands. This proposal is also under discussion.

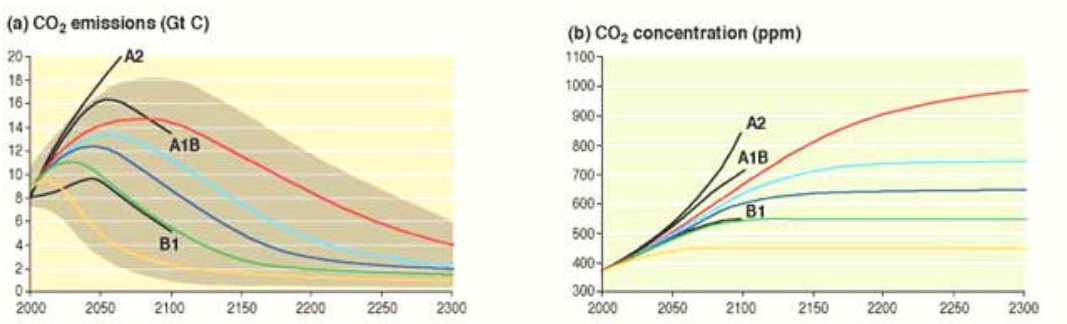
1. Introduction: The Problem

The climate change problem is being addressed through a framework convention (the United Nations Framework Convention on Climate Change (FCCC) adopted in 1992)[1] and a series of negotiated or anticipated protocols. The Convention provides a long-term objective in Article 2:

> *"The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, the stabilization 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".*

In 1997, the Kyoto Protocol to the United Nations Framework Convention on Climate Change was adopted. The Protocol includes quantitative commitments for the developed countries and designs mechanisms to help countries achieve their commitments in a cost-effective manner.[2] The Protocol sets an overall target of a reduction of 5.2% of global emissions by the year 2008-2012. This is very low in relation to the level of emission reductions that may be considered necessary in order to protect the earth from dangerous interference (see Figure 1). Of course, the determinations of whether this is low or not depends on ones interpretation of what dangerous emission levels are. The challenge remains that the sea level continues to rise long after the concentrations have been stabilised.

Figure 1: Stabilisation of CO_2 emissions (IPCC, 2001).



[1] The FCCC consists of 26 articles. It sets out a long-term goal, defines principles for developing the regime further, lists the policies and measures that countries should undertake, establishes a financial mechanism and outlines a reporting mechanism. The Convention entered into force in 1994 and has been ratified by 188 parties (including the EC). For a critical analysis of the content of the convention, see Bodansky 1993.

[2] For a critical analysis of the content of the Protocol see Oberthür and Ott 1999 and Grubb et al. 1999.

The level at which the concentrations of GHGs are eventually stabilised determines the overall level of global climate change. At the same time, the level of climate change and the severity of its impacts are highly uncertain, particularly at the regional level. Given the large uncertainties about the impacts of different stabilisation levels it is necessary to address the question: do we need to set long-term stabilisation targets in relation to GHG concentrations, and are concentrations of GHGs in the atmosphere the most appropriate indicator for setting long-term targets?

Climate change negotiations have so far focussed almost exclusively on short-term issues related to greenhouse gas mitigation in the first commitment period (2008-2012) and the use of flexibility mechanisms in the Kyoto Protocol. However, action outlined in the Kyoto Protocol represents only an initial step towards achieving the overall objective of the FCCC.

At the same time, the debate on ratification and entry into force of the Kyoto Protocol has been marked by calls to broaden the ambit of the Protocol by including developing country GHG mitigation commitments. These demands have been countered by developing countries by references to their low cumulative and current per capita GHG emissions, low per capita incomes, low GHG intensity of GDP at purchasing power parity, and high vulnerability and poor coping capacity to climate change impacts.[3] There is an increasing awareness amongst developing countries of the implications of climate change and demand for international climate policy making to deal not only with mitigation but also the issue of adaptation. Therefore there is a strong need for dialogue amongst policymakers and stakeholders about acceptable and unacceptable climate change impacts, about fair ways of dealing with the unequal distribution of impacts, and about options for a fair distribution of emission control and adaptation costs.

The level of climate change impacts is related to both the overall magnitude of the change, the rate at which it occurs, and the ability of the natural and human systems to tolerate or adapt to the change. Not all systems are equally vulnerable to climate change: some systems are likely to adapt more easily than others.[4] Human systems may adapt more easily than natural systems, while developed countries generally have more adaptive capabilities than developing countries. In assessing dangerous levels of climate change, adaptation options and capabilities need to be taken into account. This raises questions about how to evaluate different types of impacts and how to deal with regional and social differences in impacts. This also raises questions about critical impacts (impacts that should guide actions) and intergenerational solidarity (i.e. what time horizon should be taken when considering climate change impact risks).

The climate change problem basically constitutes a risk problem, where climate change impact risks need to be balanced against the risk of climate control policies. Acceptable levels of climate change will be defined in relation to the possible societal consequences of impacts, adaptation, and mitigation efforts. An assessment of non-dangerous climate

[3] For details see Gupta 2001.
[4] See IPCC WG2, 2001.

change thus also entails an assessment of the implications of climate change control policies.

Climate change scientists are unable to define what would be an acceptable level and time-frame for global concentrations of greenhouse gases to be stabilised. This is because the evaluation of climate change risks is essentially a political issue. Moreover, scientific uncertainties make it very difficult to assess the likelihood of possible climate change events and thus to quantify the risks of climate change. In short, the climate change issue is characterised as an unstructured problem where both the values at stake as well as the science are uncertain and subject to debate.

This type of post-normal science problem requires a methodological framework within which scientists, policy makers and other stakeholders can enter into a dialogue to assess what level of 'danger' (in terms of possible impacts) could be attached to different levels of climate change, what could be the implications of false policy responses (policies being either too loose or too stringent), and hence, what long-term concentration levels (or alternative policy indicators) may be considered acceptable and unacceptable, and on what grounds (criteria/values).

The climate system will respond slowly to mitigation efforts: impacts of climate change will continue to manifest themselves well beyond the moment global GHG emissions are being reduced and even after GHG concentrations have actually been stabilised. This means that short-term decisions about GHG emission control need to be evaluated from a long-term perspective, because they may foreclose long-term climate control options. This raises the question of what long-term climate change targets would imply for global emission control policies in the short to medium term (post 2012 policies). In case no long-term targets can be established, it raises the question of how we can hedge against the uncertainty about desired future levels of stabilisation of GHG concentrations. Also, here, a dialogue between scientists, policy makers and stakeholders is essential for developing proper strategic responses.

The fundamental research question is then: Given the vast differences in the national interests of countries, how can a common basis be developed for the further articulation of Article 2 of the FCCC?

In order to address the research question, this report first undertakes a brief literature review (see Chapter 2). It then explains the methodology used in the project (see Chapter 3). The report then presents the scientific framework which was provided to the stakeholders (see Chapter 4). Chapter 5 undertakes a comparative analysis of the different workshops and Chapter 6 draws some conclusions and recommendations.

2. Theoretical Issues and state of the art of science

2.1 Introduction[5]

As mentioned earlier, science cannot deal with hybrid questions that combine an evaluation of conflicting values and conflicting science. Nor do negotiations provide an appropriate arena for constructively designing policy solutions with a high compliance pull on such issues.

The following section provides the theoretical context for the approach developed in this programme. It first presents an introduction to new forms of governance and different problem types and the gaps. It then discusses conceptual issues in international relations and in international law and the gaps. It goes on to discusses conceptual issues in the science-policy interface and the gaps. The section then introduces new solutions to bridging these gaps, and concludes with the identification of overall research questions.

2.2 New forms of governance

Environmental problems are generally classified as local, fluvial, regional or sub-national, continental or regional and global.[6] But even local problems often have an international dimension in that they may be recurring internationally in different parts of the world, or because they are caused by interlinked global production and consumption chains.[7] Inevitably policies to deal with such environmental problems tend to be multi-level in character. As a result new forms of governance are emerging and are raising new types of policy and scientific problems. Based on some overview articles and some current global governance projects (Kersbergen and Waarden 1999, Glogov.org, etc.) one can argue that there are three dominant types of governance issues emerging that are relevant for this programme. These are:

- Horizontal governance: relations between states and between social actors and organisations at their level in the global hierarchy. Theories that deal with such types of governance include negotiation theory; international law principles and concepts; international relations schools of thought; regime theory; regulatory cooperation, coordination and competition; regulatory gaps and overlaps; causality, performance and design; case law and coalition theory;
- Vertical governance: focuses on relations between different levels of governance. Theories from different disciplines dealing with these are compliance-push and compliance-pull; two and three level games; subsidiarity, competence (for EU policy) and top-down global decision making; sovereignty, quasi-sovereignty, bounded sov-

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[5] This section is based on the work done primarily by J. Gupta.

[6] This classification tries to unite the terms used by the Netherlands Ministry of Housing, Spatial Planning and Environment, the Netherlands Institute for Public Health and the Environment and the International Human Dimensions Programme on Institutions.

[7] This point has been poignantly brought forward by the Commission on Environment and Development (Agarwal et al 1990).

ereignty, reduced sovereignty; network theory; development economics and dependency theories; case law; and

- Diagonal governance: focuses on relations between state and non-state actors. Theories dealing with these include interaction between public and private international law and policy; co-regulation/ corporatism and self-regulation; global integrated commodity chain analysis; philosophy of science and law (jurisprudence); post-normal science/ public interest science; participatory integrated assessment; science-policy communication; stakeholder research and analysis.

The HOT programme focuses on how tools in the context of diagonal governance can be developed to support both horizontal (e.g. negotiation) and vertical (implementation and compliance pull) governance.

2.3 Problem types

On the basis of a vast amount of literature (Hisschemöller 1993, Gupta 1997, Hisschemöller and Gupta 1999, Miles et al 2000, etc.), problems can be classified at the global level as:

- Structured[8] problems: These problems are problems in which there is vertical and horizontal consensus on the nature of the science and the values. Such problems are relatively easy to address via international negotiations.
- Moderately structured problems (horizontal): These are those problems in which the negotiators from the different states are able to agree with each other on the contours of a problem but do not have much domestic support for their views.[9] Here interests appear to converge at international level but there are strong differences of opinion on national interests.
- Moderately structured problems (vertical): These are problems that have been well discussed domestically and there is strong consensus on values and science. However, at the international level there is considerable difference of opinion.
- Unstructured problems: Finally, there are unstructured problems (also referred to in the literature as malign and wicked) where there is neither agreement on science or values between or within countries. In such cases, if a treaty is negotiated it may be limited to policy aspirations.

The HOT programme focuses on developing tools for governance that can facilitate problem solving in relation to unstructured problems. This is because we believe on the basis of past work and on the basis of the first phase of HOT that climate change is essentially an unstructured problem.

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[8] Other words used in the literature are benign, simple, etc.

[9] This is the case when the problem is signalled first at international level and international agreement tends to precede domestic agreement. This is the case also when unilateral action has only limited value and governments are afraid of free riders on the one hand; and on the other hand are taking a pioneer role upon themselves. In such a case although treaty making is possible there are severe doubts about the ability of countries to actually implement their obligations.

2.4 International relations and gaps

International relations theory focuses, inter alia, on perspectives based on different schools of thought about how the world is constructed. While realists have always argued that power politics determine solutions even in the environmental arena, regime analysts have argued that the solutions we see emerging in the international arena in relation to global commons problems cannot simply be explained in terms of power politics. They argue instead that increasingly co-operation is being institutionalised and that despite the vast differences of interests between countries progress can be made. Many argue that in the area of benign or structured issues, reaching constructive solutions is not too complicated. In general, structured problems are relatively easy calling only for the harmonisation of domestic policies. On the other hand, when it comes to complex, unstructured problems, they suggest certain practical solutions based on empirical observations of what actually works in the international arena.

Thus the literature argues that in order to increase regime effectiveness in complex problems, it is important to limit the scope of the issues under discussion. It is necessary to deal with easy issues first and to undertake a pragmatic single-issue approach (Young 1989, 1995, Sebenius 1993, Andresen and Wettestad 1992, Hansenclever, Mayer and Rittberger 1996, Miles et al 2000). In more complex co-ordination problems, negotiations could benefit greatly from using 'efficient principled' negotiation strategies (Fisher and Ury 1981). Here all countries are invited to participate in the initial stage of problem solving so as to increase the legitimacy of the dialogue and then the follow-up could be restricted to a small group of countries (Andresen and Wettestad 1992: 277-291). It is important to simplify the issue and to divide the problem into easily manageable issues. Each issue should be dealt with separately. The focus would be to build on agreement and avoid polarised issues. Deadlocks can be resolved by providing countries side-payments and other incentives and compensation (Haas 1980; Sebenius 1993; Sand 1992). This approach can be summed up as an approach that develops incrementally, avoids difficult issue-areas; develops sectoral solutions and tends to be technocratic in perspective (Gupta 1997: 177-178). This approach tend to build on the logic of consequences.

However, such techniques work best when the system has to be fine-tuned. When the problem is complex and calls for drastic structural changes, such strategies may lead to tall-chimney solutions (solutions that merely postpone the problem or transfer it to another place), divide and rule approaches, an excess reliance on technocratism and may not automatically deal with the systemic aspects of the problem.[10]

Hence, we find that although Article 2 is the corner stone of the Climate Change Convention, because it raises such complicated issues, it is continuously bypassed in discussions.

[10] If such a strategy is used in the case of moderately structured problems and unstructured problems, then it tends to exploit the lack of mandate of the negotiators from several countries and/or the imbalance in political power between countries and may lead to latent conflict between countries.

2.5 International law and gaps

International law deals with the legal aspects of interstate and international relations. On the basis of the literature, we would like to make two inter-related points. First, international law has seven functions. It aims at ensuring peace and order through the provision of rules of procedure, it provides the language of diplomacy and tools of interpretation, it codifies and harmonises state practice, it develops norms and promotes the progressive development of international law, it provides rules, it establishes organisational structures for, inter alia, dispute resolution and it influences state practice and, finally, it influences and regulates the behaviour of state and non-state actors in the promotion of international peace and security. These are both assumptions about the role of law as well as observations based on how law actually functions. Having said that, we would like to argue that these functions of law can be empirically tested in the context of structured problems. However, in the context of unstructured problems there are major difficulties in interpreting texts, which, because of the negotiations, take on a diffuse character; in promoting new norms that are commonly acceptable to all countries; and in influencing state practice. This is because countries are not necessarily consistent about their values, and their choice of norms differs from issue to issue, context to context. Thus while the OECD countries have adopted the polluter pays principle as an important legal principle within the context of the OECD, this principle has not been accepted in the context of the climate change negotiations.

This brings us to our second point. International law has traditionally evolved through harmonisation of domestic laws and through the codification of existing principles. However, in modern environmental problems, international law is developing as a result of the recommendations made by scientific institutions that are closely related, since the existing principles are inadequate for dealing with the problem. Thus, we find that it is the IPCC (Intergovernmental Panel on Climate Change) process that feeds in ideas for developing institutions and instruments for dealing with the climate change treaty. But the IPCC process does not discuss norms. There is no independent scientific process taking place that examines the international legal norms available and discusses how these norms should be developed further in order to guarantee the rule of law and justice in the international arena. This is why the new international laws being developed are taking on an increasingly 'rationalistic' character and becoming technocratic instruments for problem 'management'. We believe that this will not lead to real problem-solving. Instead we believe that prior to negotiations, there needs to be a process that allows for the determination of the values by which the problem can be addressed. In other words we believe that the logic of "appropriateness" is also important in dealing with unstructured problems

2.6 Science-policy issues and gaps

On the basis of a vast amount of literature,[11] we can argue that at the global level there are huge gaps between the scientific and the policy community (the two cultures theory). There are also gaps between competing scientific schools of thought (scientific plural-

[11] eg. Snow 1964, Caplan 1979, Rich 1991, Annan 2003, Gupta 1997/2000.

ism), different professional and problem solving cultures from local through to global levels, different professional and ideological cultures in different parts of the world and because of the structural imbalance in knowledge between the blocs.

These gaps are further aggravated by the predictions from the theories in relation to knowledge use which argue that science is either used in the public interest (normative theories), inadequately used because of poor communication between the two communities (two culture theory), used in the private interest (public choice theory), used when it is in line with existing policies and expectations (rational actor), or that policy is the result of politics and not of rational expertise.[12]

These predictions in relation to knowledge use become even more sombre at the international level, where power politics often has a dominant role in determining how science is to be used. (For example, any reasonably influential country can prevent the IPCC from including a chapter on a particular subject. The US successfully aborted the IPCC project to have a special report on climate change and sustainable development).

One can conclude that at the global level there are disciplinary gaps[13] (where each discipline or even a combination of disciplines gives only a partial analysis), expertise gaps (in relation to dealing with uncertainty, the inclusion of values and competing values in discussions, the problem of ivory tower knowledge not based on the knowledge of social actors, the problem of democratic deficit in scientific evaluation), and bloc gaps (the problem of the different levels of knowledge in different parts of the world). There are also policy gaps between different countries and between ministries within countries.

2.7 Bridging the gaps through new tools of governance

The problem identification process helps us to understand that while current tools of (global) governance can be used successfully in structured problems, the global community lacks tools to deal with unstructured problems. The international law gap leads us to focus on the need for: a preparatory phase prior to the negotiation of soft law documents in unstructured problems; the need to nurture normative communities world-wide to support the identification of common values to deal with global problems; and possibly the need for citizen juries to make choices in critical issues. The international relations gap focuses on the need for social and scientific learning processes and accelerated issue-linkages as a way to increase the avenues of finding mutual solutions. The science-policy interface discussion focuses on the inability of the communities to understand and communicate with each other, and, worse, the lack of willingness to do so because of the institutional contexts within which such discussions take place.

Public interest and post-normal scientists have tried to bridge the gap through stakeholder research and participatory integrated assessment. Policymakers have tried to bridge the gap (at primarily national level) through science-policy institutions (e.g. IPCC), stakeholder participation and focus groups, participatory technology assessments and citizens tribunals (Fischer 2001), commissions of experts (e.g. Brundtland Commis-

[12] Rich 1991, Lindblom et al. 1979, van de Vall 1998, Lazarsfeld 1967, Marin 1981, Boehmer-Christianson 1999.

[13] cf. Woodhouse and Nieusma 2001.

sion), commission of stakeholders (e.g. World Commission on Dams), tripartite agreements (e.g. the Global Compact), and Global Dialogues (e.g. the North-South dialogue, the dialogues established by the WSSD, and the Climate and Water Dialogue). Although there are some examples of global dialogues, none of these were based on any scientific principles or had any formally established rules of procedure and the term dialogue was loosely applied to these meetings. The table below sums up the disciplinary gaps and ways to bridge these gaps:

Table 1 Bridging the disciplinary gaps.

Discipline	Gap	Bridging the gap
Policy sciences	Lack of tools to deal with unstructured problems	Problem structuring processes
International relations	Power politics frames the context in which science is used especially in unstructured problems	Need for accelerated strategies such as appropriate issue-linkages; Need for social and scientific learning to help social actors broaden their horizons beyond narrow personal and state interests
International law	Lack of a preparatory phase prior to the negotiation of soft law documents in unstructured problems; Lack of new norms at the global level; Too much reliance on negotiation processes based on power politics to solve global problems does not lead to solutions	The need for a preparatory phase – possibly through a dialogue; The need to nurture normative communities world-wide to support the identification of common values to deal with global problems; The need for citizen juries to evaluate the state of current science and values in order to address global problems
Policy Use theories	Culture gap between and among policy and scientific communities at the horizontal, vertical and diagonal level; Mono-disciplinary, regional and ivory tower bias; Personal, national and political motivations cloud the ability of the policymaker to use to science in the public interest	Science-policy dialogue at national through to global levels
The dialogue process	Information about knowledge gaps in specific areas and in relation to combination of knowledge	Developing a scientific process for seeking answers to these specific questions through a matching of scientist with question

Bringing the different ideas together, we argue that there is need for:

- structuring the problem;
- through identifying and addressing the information needs;
- through developing a modus operandi to deal with uncertainty;
- through identifying the different values of the different actors;
- through understanding and trying to develop common value systems that apply to all countries;
- through understanding the different interests involved;
- through re-defining the problem to increase the space for reaching common understanding of the issues and learning to respect the views and values of others.

This can be attempted through a number of different tools including:

- interactional series of local through to global science-policy dialogues;
- support from links with scientific communities;
- development of normative communities that support the development and interpretation of common norms (e.g. the human rights communities);
- the use of issue-linkages to help prioritise the problem at hand, especially for the less powerful countries, and
- the possibility of using citizen juries to decide on critical issues.

The dialogues can become effective if they openly:

- politicise arguments; become explicit about the political choices;
- make value systems explicit and transparent;
- nationalise arguments (use-issue linkages with national priorities); and at the same time;
- de-nationalise the arguments (in search of what is good for all).

The purpose of these instruments is to enable social and scientific learning, to adopt a truth and reconciliation approach, and to build the necessary social capital in order for societies to work towards sustainable development.

2.8 Formulating research questions

Therefore, the **overall research question** for this programme is:

Can an interacting set of global, regional and national dialogues between stakeholders in a non-confrontational setting provide opportunities for social and scientific learning that can enhance the long-term, prospects for global cooperation on complex problems such as climate change?

Phase 1 of HOT focused on identifying the global support for such an idea; Phase 2 will focus on experimenting further with the idea and leading to both social and scientific learning on the one hand and to theoretical insights on the other hand. Phase 3 will focus on testing whether social and scientific learning actually contributes to more informed negotiations, better lawmaking and sustainable development through the identification of clear environmental goals.

Regarding the more **specific research questions** a distinction can be made between substantive and process–oriented questions. The substantive questions are related to the in-

formation demands of the dialogue. These will be steered by the dialogue itself, but are likely to include the following:

1. How can Article 2 of the FCCC be elaborated into quantitative indicators for climate change control? What operational criteria could be developed to indicate dangerous and non-dangerous levels of anthropogenic interference with the climate system? What indicators can be selected that are both politically relevant and publicly comprehensible and appealing, and can be scientifically substantiated (attributable to climate change, reliable/valid, measurable, predictable)? How can different indicators be aggregated?
2. What are the options for adaptation to avoid exceeding thresholds levels? What level of adaptation is feasible and acceptable?
3. How can the indicator levels be related to the cause – effect chain of climate change? How are the indicator levels and the risks of exceeding of critical levels related to levels of climate change? How can the levels of climate change be related to long-term goals for stabilisation of greenhouse gas concentrations? How do these long-term concentration levels relate to greenhouse gas emission levels on the long term and the short-term? What would be the implications of limiting the risks of exceeding long-term indicators thresholds levels for global emission control on the short- to medium term (the post Kyoto period)?
4. What are the options and costs of meeting long-term stabilisation targets? How are its feasibility and costs related to socio-economic and technological developments, social and institutional barriers, and the timing of mitigation efforts? How can risks of high future policy adjustment costs be limited (e.g. hedging)?
5. How can we deal with the unequal distribution of climate impacts and mitigation capabilities? What can be the role of supporting adaptation and/or providing compensation? How can mitigation costs be (e)valuated against adaptation costs/climate impacts?
6. What is the value of climate indicators and long-term climate targets for developing an effective international climate change regime and rallying societal support for dealing with climate change?

In particular Phase 1 focused on an inventory and preliminary discussion of these issues at national and/or regional level, as well as some initial experimentation with the rules of procedure for developing such a dialogue.

The Phase 1dialogue aimed to understand:

- What do participants understand as key issues in Article 2?
- What are the key knowledge gaps that need to be addressed?
- Do participants believe that a discussion of Article 2 is critical for the future development of the climate change regime?
- Did the regional and / or national dialogue increase the level of understanding of the participants?
- Do the participants see a need for an interacting set of global and national dialogues as a first step towards the process of further elaborating on Article 2 of the climate change convention?

3. Phase 1 Research Protocol

3.1 Introduction

A methodological protocol was developed for the programme, of which this project is the first step. This chapter explains the methodology used in this first phase of the programme; it first explains the framework of the dialogues (4.2), discusses the key actors in HOT (4.3), explains the need for pre-dialogue preparations (4.4), gives the structure of the workshops (4.5), and finally identifies an approach for collating the information (4.6).

3.2 Framework of the Dialogues

The overall framework of the HOT dialogues is represented in the figure below – a set of iterative dialogues moving from pre-dialogue preparation to regional and national dialogues to a global dialogue (and then back out again). Phase 1 is comprised of the initial dialogue preparation and the first regional and national dialogues. The regional and national dialogues then provide input and lessons learned for the global dialogues (Phase 2) which in turn provide input for the second round of regional and national dialogues.

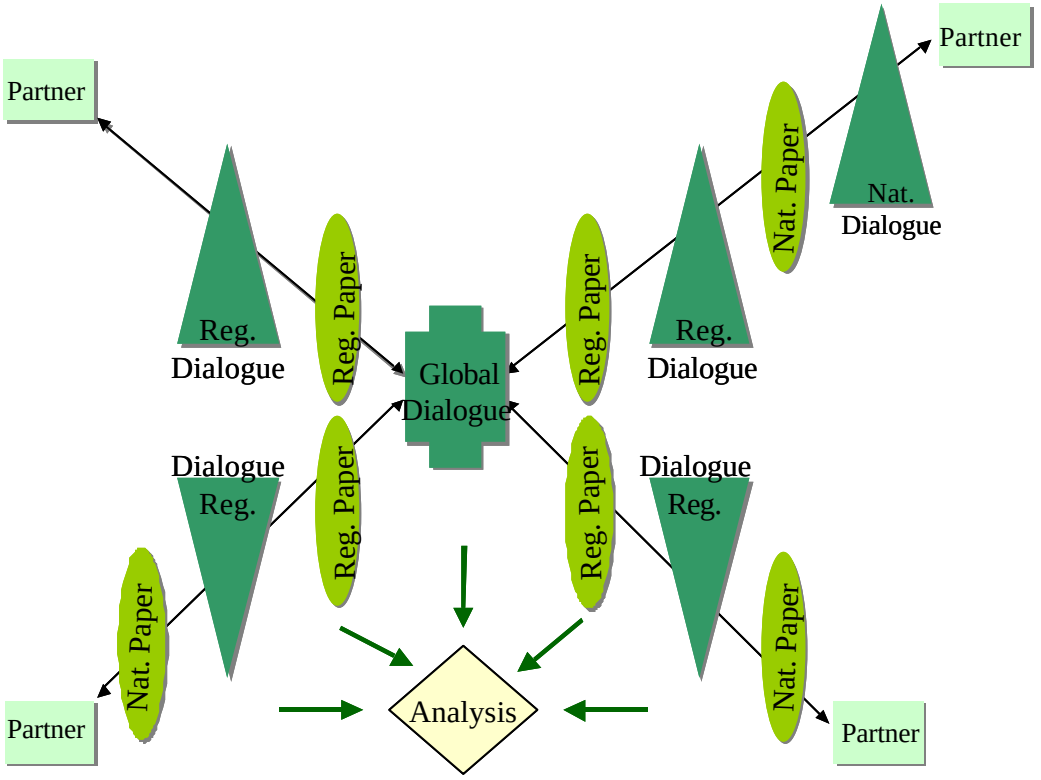


Figure 2 A schematic overview of the interactional set of dialogues.

3.3 Key Actors

The actors in HOT can be split into two categories, the project partners and the actual dialogue participants. The partners make up a research consortium which both organizes and studies the dialogue as well as providing the scientific input. They include:

- Coordinating Partners – IVM, RIVM and TERI. The IVM will serve as the lead and is therefore the project office;
- Regional Partners – ENDA, TERI, COPPE, RIVM;
- Scientific Partners – Tyndall and COPPE;

In terms of participants, the relevant stakeholders were identified from government, public NGOs, private NGOs, potential losers from environmental regulation, scientists/researchers, and the media. The regional partners were relied upon to identify the major players in their area.

In the actual dialogues there were also key roles for Procedural and Substantive Chairs and Recorders. The procedural and substantive chairs provided guidance to the dialogues by both guiding the content of discussion in useful directions and by ensuring that discussion remained respectful and comfortable for all participants. Recorders were necessary to provide a record of the dialogue, but since participants may have felt constrained by this activity, it was agreed that comments would not be attributed to individual participants.

3.4 Pre-Dialogue Preparations/Consultations

In order for the dialogues to be effective, the ground had to be prepared ahead of time. This meant understanding the key issues and sounding out stakeholders in advance, so that the dialogue would result in meaningful interaction.

For the partners this meant that they know how to run a dialogue. For the stakeholders this meant understanding: the key issues related to Article 2: the consequences and outcomes of climate change policies: issues of controversy: the role of science: and their own expectations and desires. The scientists involved prepared a concise background paper dealing with scientific perspectives on Article 2 (see Chapter 3). In addition, they tried to provide region-specific information on the possible impacts of climate change and options for adaptation and mitigation; as well as general information to introduce stakeholders to the ideas of vulnerability to climate change, and adaptive capacity. This was done on the basis of the needs expressed by the stakeholders.

Finally, the method of gathering and collating the information was established. Each partner was responsible for the format for their region whether it was phone or written surveys, workshops, etc. The synthesis of this information was used to form the structure of the regional dialogue.

3.5 Methodology for the Regional Dialogues

This section details how the regional dialogues themselves were conducted.

Criteria for selecting participants for the regional meetings were as follows: Approximately 20 individuals were selected from the various groups of stakeholders. It was at-

tempted to have the participants represent the viewpoint of a significant population, be positive towards the project, able to participate fully, be well prepared, and willing to make a contribution. It was hoped that a substantial portion of the participants would be able to continue with Phase Two of the dialogue. A tentative plan calls for approximately 1/3 of the participants from each dialogue to move onto the global dialogue.

The meetings had the following structure: 1) Introductory session – a meet and greet: 2) Issues for the agenda – discussion of draft agenda: 3) Rules of procedure – procedural rules are agreed by all: 4)Roles in the dialogue – roles of each person are explained; 5) Discussion – substantive issues were aired. The content of the dialogue was then analysed and evaluated so as to discern areas of disagreement and overlap between the parties, and deepen future discussions.

The dialogues hinged on the participants being candid and uninhibited. This meant that privacy was assured, but also that they understood the expectations and risks of the dialogue before hand, i.e. what they were getting into and what they would get out of it. They also had to understand the procedure so that there were no surprises.

The partners were also prepared for the risks that presented themselves from their side. These included: participants not committing their time and offering their opinions; the dialogues are beyond participant levels of comprehension; too many irresolvable differences among participants; and negative or hostile participants. The substantive and procedural chair aimed to prevent these problems, however some were unavoidable.

3.6 Collating the information

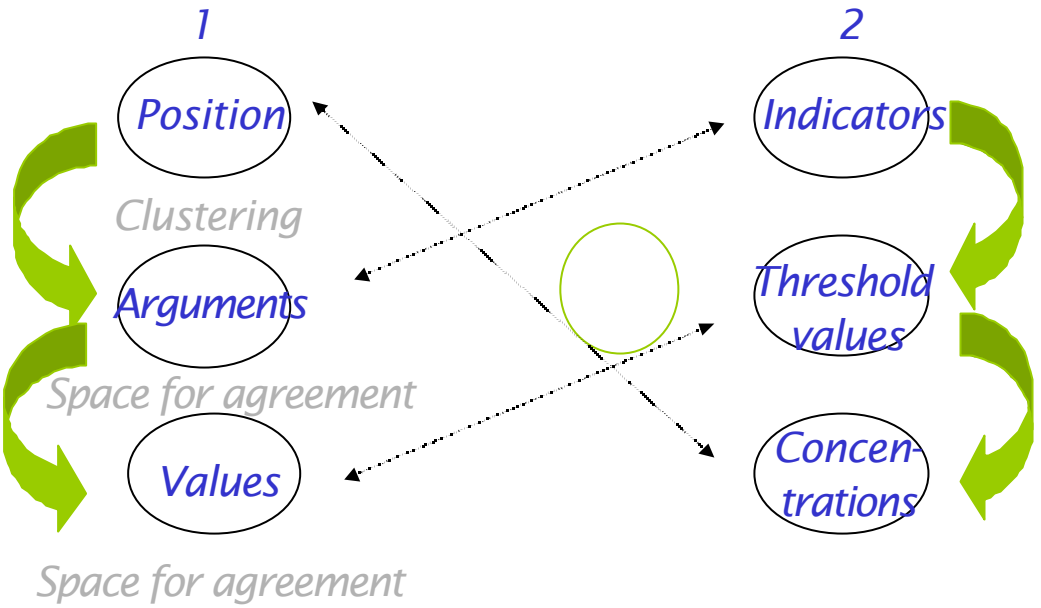
The structure of the meeting was based on the "clustering" of similar views. These clusters were based on the participants' positions on Article 2. Many alternative clusterings were possible and the appropriate divisions depended on the people who responded, the level of depth in their responses and the analytical traction provided by the grouping. Participants were welcome to give input on the clustering.

Once the clustering was completed, the responses within the cluster could have been analysed to understand the factual and causal claims and value statements explicitly stated or implied by the arguments. We anticipated that a hierarchy in the level of argument would appear thus:

- Positions (policy claims);
- Interests;
- Reality Claims – facts, causality;
- Normative Claims – Cultural values, social roles and status, geography, history etc.

However, the preparation for most of the workshops revealed that in the first stage we could only hope to make an inventory of positions and informational needs given the degree of complexity of the problem. Hence, in order to make the discussions less complex and abstract and to link them to domestic priorities and concerns, the dialogues took a different approach. Instead of focusing on what concentration levels are necessary to avoid "dangerous" interference with the climate system, the dialogues began by working backwards. That is, they started with the sort of outcomes that could be considered acceptable and unacceptable, and then worked their way back to the concentration levels

that correspond to these acceptable or unacceptable outcomes. Hence a combination of two approaches as depicted in the figure below was used.



Once participants were satisfied that their arguments were fairly represented, they could then begin to see how different actors saw the problem of climate change. Considering whether the differing arguments were **reasonable** or **unreasonable,** and questioning their basis, allowed for the introduction of **space** into the process – that is, room for parties to manoeuvre and change their assessment of the situation.

The point of the dialogues was not to change the participants' negotiating positions however. Dialogue success rather, was defined as a situation in which participants from different groups listened openly to each other, felt that they were truly listened to, were fully involved in the discussion, and were given a chance to reflect on their own position without compromising their core values. The point is that the dialogues are not related to political negotiations. The overall aim of the exercise is to increase understanding and explore new areas of agreement by providing a neutral and open environment – not to directly impact the ongoing climate negotiations.

What became increasingly apparent however, was that most of the participants neither had a clear-cut position on Article 2 based on reasoned arguments, detailed estimates of indicators, nor perceptions of threshold values. Instead they were still at the stage of calling for more information in order to be able to make an informed position. Although we initially did intend to cluster the different views, we discovered that in most cases it made more sense to inventorize the informational needs emerging from the different perspectives. It is anticipated that dealing with these informational needs will help to provide a common starting point for developing different positions.

4. Scientific input[14]

4.1 Introduction

This chapter provides a brief overview of the state of the scientific knowledge surrounding the definition of dangerous climate change, in order to set the scene for the regional dialogues being carried out as part of phase one of the HOT project. The HOT project is being undertaken in the context of a recognition that an understanding of what constitutes dangerous climate change as laid down in Article 2 of the United Nations Framework Convention on Climate Change (FCCC) is of great importance to debates around present and future climate policy.[1]

4.2 Non-anthropogenic versus anthropogenic climate change

Along with world population growth and global economic expansion over the past century, intensified human activities, particularly energy intensive activities, have altered the properties of the Earth's atmosphere. This has altered the functioning of the global climate system. As concluded by the latest assessment report of the Intergovernmental Panel on Climate Change (IPCC, 2001a), the Earth's climate system has demonstrably changed on both global and regional scales since the pre-industrial era, with at least some of these changes clearly attributable to human activities.

The global annual average surface air temperature has been increasing since 1860, when the instrumental record started. In the twentieth century, the Earth's surface temperature increased by about 0.6°C, with the 1990s being the warmest decade and 1998 the warmest year. Using proxy data for the Northern Hemisphere, hemispheric temperature series have been established for the past millennium (IPCC 2001a). This reconstruction indicates that the 1990s is likely to have been the warmest decade in the past thousand years.

As well as the rise in global average temperature, changes in other features of global climate have also taken place -- precipitation has very likely increased during the twentieth century by 5 to 10 per cent over most mid- and high latitudes of the Northern Hemisphere continents; global average sea level rose by between 1 and 2 mm per year during the past 100 years; snow cover and sea-ice extent have generally decreased, especially in the Northern Hemisphere; and warm episodes of the El Niño/Southern Oscillation (ENSO) phenomenon have become more frequent, persistent and intense since the mid-1970s, compared with the previous 100 years.

With so much evidence for changes in the Earth's climate, one would naturally ask the question what has caused this change? Global climate varies naturally, due both to what is called 'internal variability' within the climate system and to changes in external forcing unrelated to human behaviour – for example, changes in solar irradiance and volcanic activity. The reconstruction of temperature over the past thousand years suggests, however, that the warming over the twentieth century is unusual and unlikely to be

[14] Prepared by Alex Haxeltine of the Tyndall Centre for Climate Change Research, May 2003.

merely the response of the system to natural forcing. Indeed, detection and attribution studies consistently find evidence for an anthropogenic signal in the climate record of the last 35 to 50 years, despite uncertainties in forcing due to anthropogenic aerosols and natural factors. Furthermore, recent climate model experiments show that natural causes of global temperature variability cannot, on their own, explain the observed surface warming of about 0.6°C. When these experiments are repeated using rising historic concentrations of greenhouse gases and shifting distributions of sulphate aerosols, much better agreement between observed and modelled global patterns of temperature change is achieved. Hence, the latest IPCC Assessment concluded that,

"… there is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities." (IPCC, 2001a).

With the inertia in our energy systems and the long memory exhibited by the climate system, this human-induced climate change will continue in the decades and centuries to come. Actions to mitigate climate change may yet slow the rate of climate change, but will not stop it. To better prepare our societies for the potential changes in climate, considerable efforts have been made to project the likely regional and global climatic consequences of a range of plausible socio-economic development pathways.

Taking into account a wide range of possible future greenhouse gas emissions and embracing the uncertainty implicit in climate modelling, the globally-averaged surface air temperature is projected to rise by 1.4° to 5.8°C over the period 1990 to 2100 (IPCC, 2001a). This magnitude of change is about two to ten times larger than the warming observed over the twentieth century. Based on paleoclimate data, this projected rate of change is very likely to be without precedent during at least the last 10,000 years. Corresponding to the range of change in global temperature, global-average sea level is projected to rise by 9 to 88 cm between the years 1990 to 2100. Globally-averaged precipitation is also projected to increase during the twenty-first century. Changes in some climatic variables can be substantially different from the global-average at the regional scale, and for some variables such as precipitation, cloud cover and relative humidity, the sign of change might even be different from region to region.

Apart from changes in average climatic features, the build-up of atmospheric greenhouse gases is projected to change the duration, location, frequency and intensity of extremes of weather (for example, heatwaves, intense rainfall events, tropical cyclones, etc.), which would alter and/or disrupt the functioning of many natural biophysical and human socio-economic systems.

In the face of certainly continuing, probably accelerating and possibly unprecedented changes in the Earth's climate over the upcoming decades and centuries, what should be our response? As evidence is emerging that some physical and biological systems are already reacting to climate change, and as we know that at least for some regions and for some communities climate variability already imposes huge costs, doing nothing is unlikely to be the best option. Humanity needs to develop and implement appropriate strategies to reduce the risks associated with climate change – to ensure that changing climatic resources are exploited and that changing climatic hazards are minimised. Mitigation measures are required to reduce global greenhouse gas emissions with the intention of eventually stabilising atmospheric concentrations at a level at which an accept-

able dynamic equilibrium could be sustained between climate, ecosystems and human society. On the other hand, due to the inertia of the climate system, greenhouse gases accumulated in the atmosphere since the pre-industrial era will continue to affect global climate long into the future. This makes adaptive measures inevitable in order to enhance the coping range of ecological and socio-economic systems.

4.3 Science's role in defining dangerous climate change

The Delhi Declaration on Climate Change and Sustainable Development[2], which emerged in October 2002 from the Eighth Conference of the Parties to the United Nations Framework Convention on Climate Change (FCCC) reiterates the need to avoid dangerous climate change as the FCCC's ultimate objective.[3] According to the Third Assessment Report (TAR) of the Intergovernmental Panel on Climate Change (IPCC), however, deciding what constitutes dangerous climate change is a value judgement beyond the remit of the IPCC and perhaps of science itself.[4] Indeed, there is no universally established methodology or process for deciding what constitutes a dangerous level of climate change, and for whom.[5] Nonetheless, implicitly or explicitly, researchers have suggested arbitrary thresholds in climate change, or in the impacts of climate change, which they themselves designate as dangerous, undesirable or to be avoided. Some contrasting examples are shown below:

Examples of external definitions of dangerous climate change

Danger measured through threshold in physical vulnerability

- Large-scale eradication of coral reef systems [6]
- Disintegration of the West Antarctic Ice Sheet [7]
- Breakdown of the thermohaline circulation [8]
- Qualitative modification of crucial climate-system patterns such as ENSO, NAO [9]
- Climate change exceeding the rate at which biomes can migrate [10]

Danger measured through threshold in social vulnerability

- Irrigation demand exceeding 50% of seasonal water usage for agriculture in northern Victoria [11]
- Depopulation of sovereign atoll countries [12]
- Additional millions of people at risk from water shortage, malaria, hunger and coastal flooding [13]
- Destabilisation of international order by environmental refugees and emergence of conflicts [14]
- World impacts exceeding a threshold percentage of GDP [15]

4.4 Internal versus external definitions of dangerous climate change

So far most of the scientific research on defining dangerous climate change has focused on what we term external definitions of danger. External definitions are usually based on risk analysis of system characteristics of the physical or social world. Recent work at the Tyndall Centre has emphasized that research on defining dangerous climate change or in developing sustainable responses must recognise the central role played by perceptions of danger. There are therefore competing perspectives on dangerous climate change, what we term 'external' and 'internal' definitions of risk. Internal definitions of danger

recognise that to be real, danger has to be either experienced or to be perceived – it is the individual or collective experience or perception of insecurity or lack of safety that constitutes the danger. A robust policy response must appreciate both external and internal definitions of danger.

The research process leading to these various definitions of danger has followed two different paradigms. The more frequently followed paradigm utilises what we term 'top-down' methods.[16] This framework (upper left triangle in Figure 1) follows an essentially linear approach and quantifies indicators of physical vulnerability based on scenarios of future socio-economic change that are used as inputs to a series of hierarchical models. These types of assessments typically define danger, either globally or locally, in terms of physical measures (e.g., affected crop yield or water availability), threats to the continued function of some part of the non-human world, or in terms of people at risk or reduction in economic welfare. The scenarios used often assume no adaptation will take place as the danger threshold is approached. Sometimes a single adaptation action is assumed and modelled, while a few analyses assume adaptation occurs simply on the basis of rational choice.[17]

The 'bottom-up' approach (as shown by the bottom left triangle in Figure 1) focuses on the social vulnerability of individuals or groups to both existing climate variability and climatic change. This approach tests social and economic theories of the determinants of vulnerability across a region or between socio-economic groups, leading to social indicators of danger and vulnerability such as poverty, lack of access to health or other services, or lack of empowerment.[18] This approach also uses reasoning by analogy, i.e., learning from past experience of how communities have coped with extreme events.[19] In contrast to 'top-down' methods, recognising adaptive capacity is usually implicit in such approaches.

There are also a few attempts to integrate these two approaches to try to derive a more holistic definition of vulnerability for the purposes of adaptation to a changing climate.[20] While recognising the scientific value and policy relevance of these research efforts, we note that all these definitions of danger remain 'external' in the sense that they are observed or modelled according to judgements of individual or collectives of scientists.

But danger can also be defined in terms of insecurity or lack of safety. So, for example, in the context of climate change it is the perceived insecurity arising from realised or anticipated impacts associated with changing extreme weather events, and often immediate threats to life and livelihood, which are of greatest concern to individuals or, collectively, to society. This definition of dangerous climate change is therefore based on psychological, social, moral, institutional and cultural processes that influence perceptions of individuals and societies about what constitutes danger.[21] The perceptions of danger are determined by personal experience, values, information and trust (Figure 1).

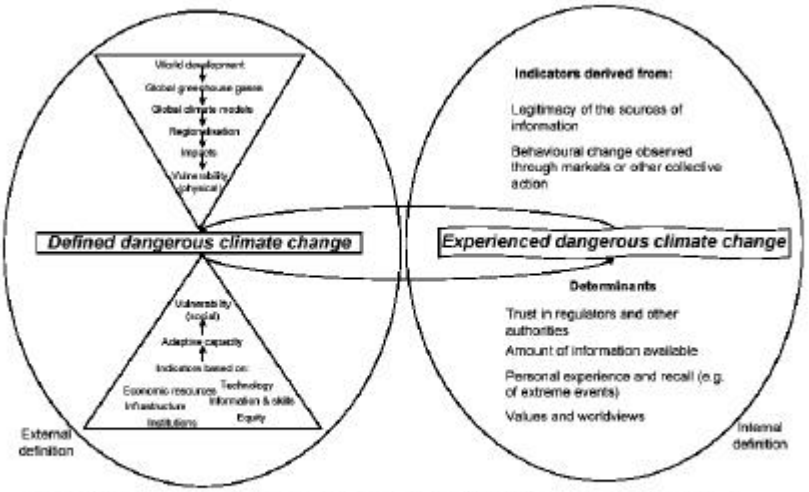


Figure 1. Components of external and internal definitions of dangerous climate change

These external and internal definitions of dangerous climate change interact with each other. Perceptions of what is dangerous are, to an extent, informed by a technical analysis of risk (external definition), for example as provided by the IPCC in the form of a state-of-the-art assessment of the science of climate change. The amount of information, the legitimacy of who gives the information and the other determinants shown in Figure 1, will transform this external definition into perception of what constitutes dangerous climate change (internal definition). Information on the risk of an individual's house being flooded or discussion about the widespread collapse of coral reefs, for example, do much to formulate perceptions of danger. Conversely, societal or individual perceptions of what constitutes dangerous climate change will have an impact on the way it is researched and externally defined, hence the arrows between the two definitions in Figure 1. A further dimension of this analysis is the role of expectations and how external definitions of danger can change individual behaviour. The prediction that an atoll country would become effectively uninhabitable through reduced land area and water availability, for example, could change behaviour such that resources would be over-exploited making the uninhabitability more likely and the prediction self-fulfilling. [22]

These examples show that definitions of dangerous climate change are socially constructed and involve deeply reflexive processes[23] made up of the interplay between external and internal definitions. Thus climate change science exhibits the classic characteristics of strong uncertainty and of a 'post-normal' science in terms of framing and execution of links to public policy.[24]

4.5 The potential contribution of the HOT dialogue

The HOT dialogue has the potential to break new ground by combining scientific insights with dialogue on Article 2 (including the definition of dangerous climate change), and it is in this spirit which this briefing paper is presented.

The preceding discussion highlights that it is important to understand the assumptions implicit in external definitions of dangerous climate change and their implications for

perceptions of danger. The internal perceptions of danger have been considerably under-researched in the area of climate change (but the distinction between 'danger' as an objective measure and danger as experienced is well recognised in other areas e.g. in understanding the causes and consequences of famine). The HOT dialogue should therefore attempt to recognise and be aware of the internal/external distinction in its exploration of ways to operationalise Article 2.

The purpose of this paper should not be to prescribe the dialogue in anyway. However, such a background paper clearly plays a role in framing the dialogue, and this should be made explicit. Thus the remainder of this paper aims to providing a framing for some of the issues that might be addressed in the first phase of the dialogue. Section 2 provides a sketch -- by region -- of the major vulnerabilities to climate change presented as an overview and for three sample sectors: agriculture, water and biodiversity and natural ecosystems. These sectors were chosen by the HOT core project team as being a relevant subsample for the initial framing of the HOT dialogues, and subsequent HOT briefing papers may well address additional sectors. Section 3 addresses indicators, thresholds and adaptation. One way to proceed with a dialogue on defining dangerous climate change is to identify indicators of dangerous climate change and concomitant threshold values that represent the limits of acceptable levels of the impact. The aim in this section then is specifically not to influence the dialogue with a in-depth discussion of indicators and thresholds but rather to set the scene for the HOT dialogue itself to generate original insights into suitable indicators and likely "dangerous" values or thresholds for these indicators.

4.6 A regional overview of vulnerabilities to climate change

The IPCC Third Assessment Report provides an authoritative synthesis of the current state of scientific knowledge on vulnerabilities to climate change (IPCC 2001b). Here we present a broad overview of the major vulnerabilities for different regions with a focus on the selected sectors of water resources, food security, and biodiversity and natural ecosystems. This overview is based largely on the IPCC assessment supplemented with some more recent sources: the aim is not to give a comprehensive overview of impacts but simply to provide an indicative framing of some of the key vulnerabilities as a basis for the dialogues within the HOT project.

In this paper we address mainly vulnerabilities rather than impacts. This is because a discussion of impacts requires an estimate an actual magnitude of climate change at some future date, and this requires a climate change scenario. As future magnitudes of climate change will be crucially dependent on what happens to anthropogenic emissions of greenhouse gases, the definition of appropriate climate scenarios is a very complex task - one which we do not wish to address in this paper. Rather by addressing vulnerabilities to climate change the focus is placed on the system that will be impacted by climate change. The IPCC defines vulnerability as follows:

> *The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity* (IPCC 2001b, p995).

Note that this definition emphasizes that vulnerability is not just a function of the absolute magnitude of a change in a climate variable, but also of the rate at which it changes. The vulnerability of a forest ecosystem to climate change would be a good example: if the rate of change of climate is below a certain threshold new tree species might be able to migrate to new sites as the climate changes, but above a certain rate of change the climate will be changing at a rate greater than the maximum rate of migration of the relevant tree species and the ecosystem will experience an increased level of vulnerability.

The key climatic variables usually associated with assessing vulnerabilities to climate change are temperature and precipitation. However, increased levels of carbon dioxide in the atmosphere also crucially have a direct affect natural ecosystems and especially vegetation. This direct effect is complex as it tends to involve both a reduction in evapotranspiration and a stimulation of photosynthesis (and thus carbon uptake). This should be born in mind when evaluating scientific estimates of vulnerabilities. For example, in some sub-regions a decrease in precipitation may be offset by the direct effects of increased atmospheric carbon dioxide.

It is hoped that the sketch of vulnerabilities provided here will provide a basis for an exploration of likely key vulnerabilities of regional systems in the HOT dialogue.

4.7 Africa

The IPCC TAR synthesis report (IPCC 2001) concludes that Africa should be considered as highly vulnerable to climate change. This conclusion was based upon the fact that: 1) a large part of the continent is dry sub-humid to arid, and the dominant impact of climate change is predicted to be a reduction in soil moisture in sub-humid zones and a reduction in runoff; 2) Africa will be especially vulnerable to climate change because of a number of current factors such as widespread poverty, recurrent droughts, inequitable land distribution, and overdependence of rainfed agriculture.

The TAR (IPCC 2001b, chapter 10) highlights six key areas of vulnerability to climate change for Africa:

- Water resources, especially in international shared basins where there is a potential for conflict and a need for regional coordination in water management.
- Food security at risk from declines in agricultural production and uncertain climate.
- Natural resource productivity at risk and biodiversity that might be irreversibly lost.
- Vector and Water-borne diseases, especially in areas with inadequate health infrastructure.
- Coastal zones vulnerable to sea-level rise, particularly roads, bridges, buildings, and other infrastructure that is exposed to flooding and other extreme events.
- Exacerbation of desertification by changes in rainfall and intensified land use.

Here we address water resources, food security and natural ecosystems in more detail.

4.7.1 Water Resources

Water resources are a key area of vulnerability in Africa, affecting water supply for household use, agriculture, and industry. Trends in regional per capita water availability in Africa over the past half century show that water availability has diminished by an astonishing 75% (IPCC 2001, p261). Although the past 2 decades have experienced reductions in river flows, especially in sub-Saharan West Africa, the trend mainly reflects the impact of population growth (population quadrupled in most countries during this period). The continuation of existing multiple pressures on water resources combined with climate change impacts is likely to accentuate water scarcity in most sub-humid regions of Africa.

Key risks from climate change include:

- Reduction in soil moisture in dry sub-humid zones leading to implications for both natural ecosystems and agriculture; Reduction in runoff, current trends indicate a decreasing runoff of some 17% over the past decade.
- Shared river basins where there is a potential for conflict (and where regional cooperation protocols can minimize adverse impacts and potential for conflicts).
- The gradual yet dramatic disappearance of glaciers on Mount Kilimanjaro is a result of a warming in recent decades (IPCC 2001b). Other glaciers in Africa are under a similar threat.

4.7.2 Food Security

There is a wide consensus that climate change, will worsen food security in Africa, mainly through increased extremes and temporal/spatial shifts (IPCC 2001b, Chapter 10). Africa already experiences a major deficit in food production in many areas.

Key risks from climate change include:

- Potential declines in soil moisture adding to the existing food deficit burden.
- Climate change induced water stress together with land degradation rendering inland fisheries more vulnerable to episodic drought and habitat destruction.
- Ocean warming is likely to impact coastal marine fisheries.
- Food importing countries will be vulnerable to the effects of impacts on agriculture elsewhere.

4.7.3 Biodiversity and Natural Ecosystems

The TAR concludes that, in Africa, irreversible losses of biodiversity could be accelerated by climate change (IPCC 2001).

Key risks from climate change include:

- Vulnerability of biodiversity-rich biomes: Climate change leading to drastic shifts of biodiversity-rich biomes such as the Succulent Karoo in South Africa. In many cases natural (e.g. oceans) or man-made (e.g. settlements) barriers will greatly increase the threat to biodiversity as biomes are unable to shift to new areas.

- Vulnerability of natural ecosystems due to the impacts of climate change on fire regimes: changes in fire regimes and habitat modification from land-use change may negate natural adaptive processes and lead to extinctions.
- Climate change induced changes in ecosystems will affect water supply fuelwood and other services.

4.8 Asia

The TAR concludes that climate change will impose significant stress on resources throughout the Asian region (IPCC 2001, p263). It goes on to state that natural resources are already under stress in many areas, and the resilience of most sectors in Asia to climate change is poor. Many countries are socio-economically dependent on natural resources such as water, forests, grassland and rangeland, and fisheries. The magnitude of change in climate variables would differ significantly across Asian sub-regions and countries.

Major risks linked to change in climate and its variability over Asia identified in the TR include (IPCC 2001b, chapter 11):

- The large deltas and coastal low-lying areas of Asia could be inundated by sea-level rise.
- Many developing countries in Asia are already vulnerable to extreme climate events such as droughts and floods, and climate change could exacerbate these vulnerabilities.
- Increased precipitation intensity, particularly during the summer monsoon, could increase flood-prone areas in temperate and tropical Asia.
- There is also a potential for drier conditions in arid and semi-arid Asia during the summer, which could lead to more severe droughts.
- Freshwater availability is expected to be highly vulnerable to climate change.
- Tropical cyclones could become more intense. Combined with sea-level rise, this impact would result in enhanced risk of loss of life and properties in coastal low-lying areas of cyclone prone countries of Asia.
- Agriculture would be threatened by a combination of thermal and water stresses, sea-level rise, increased flooding, and strong winds associated with tropical cyclones.
- Warmer and wetter conditions would increase the potential for a higher incidence of heat-related and infectious diseases in tropical and temperate Asia.
- Climate change would exacerbate threats to biodiversity resulting from land-use/cover change and population pressure in Asia.

Several risks associated specifically with boreal Asia were also identified:

- Permafrost degradation due to climate change would increase the vulnerability of many climate-dependent sectors affecting the economy in boreal Asia.
- Surface runoff increases during spring and summer would be pronounced in Boreal Asia.
- Frequency of forest fires is expected to increase in Boreal Asia.

Here we address water resources, food security and natural ecosystems in more detail.

4.8.1 Water Resources

Freshwater availability is expected to be highly vulnerable to climate change (IPCC 2001, p265).

Key risks from climate change include:

- Vulnerability of freshwater supplies: Growing populations and concentrations of population in urban areas will exert increasing pressures on water availability and water quality.
- The TAR suggests that water could become a scarce commodity in many south and southeast Asian countries, particularly where reservoir facilities to store water for irrigation are minimal.
- Surface runoff is expected to decrease drastically in arid and semi-arid Asia.

4.9 Food Security

The TAR concludes that food security appears to be the primary concern for Asia. Crop production and aquaculture would be threatened by thermal and water stresses, sea-level rise, increased flooding, and strong winds associated with intense tropical cyclones (IPCC 2001, p265). In general it is expected that areas in mid- and high latitudes will experience increases in crop yields; yields in lower latitudes will generally decrease. Climatic variability and change will also affect both the timing and duration of the cropping season.

Key risks from climate change include:

- In China yields of several major crops are expected to decline as a result of climate change.
- Acute water shortages combined with thermal stress could adversely affect wheat, and more severely, rice productivity in India (even under the positive affects of future elevated carbon dioxide levels).
- Crop diseases such as wheat scab, rice blast, and sheath and culm blight of rice could become more widespread in temperate and tropical regions of Asia if the climate becomes warmer and wetter.
- Multiple threats to aquaculture as wild stocks that are already under stress as a result of over exploitation are further stressed by the effects of climate change (such as marine productivity being impacted by plankton shifts resulting from temperature changes).

4.9.1 Biodiversity and Natural Ecosystems

The TAR concludes that climate change would exacerbate current threats to biodiversity resulting from land-use/cover change and population pressure in Asia (IPCC 2001, p265). The TAR found that risks to species are increasing, with for example as many as 1,250 of 15,000 higher plant species under threat in India (and similar trends being evident in China, Malaysia, Myanmar, and Thailand).

Key risks from climate change include:

- Many species are likely to be exterminated as a result of the synergistic effects of climate change and habitat fragmentation.
- In Asia's desert ecosystems increased frequency of droughts may result in a decline in local forage around oases, causing mass mortality among local fauna and threatening their existence.
- Mangrove ecosystems will be severely threatened by sea-level rises.
- The frequency of forest fires is expected to increase in boreal Asia.

4.10 Latin America

In many sub-regions of Latin America, current variability in climate is associated with phenomena that already produce impacts with important socio-economic and environmental consequences; and the TAR concludes that these consequences could be exacerbated by global warming and its associated weather and climate changes (IPCC 2001, p271). ENSO is currently responsible for a large part of the climate variability at interannual scales in Latin America. The region is vulnerable to El Nino, with impacts varying across the continent.

4.10.1 Water Resources

The TAR highlights the fact that few specific water resource impact studies using climate change scenarios have been conducted in Latin America.

Key risks from climate change include:

- In some Latin American areas it is likely that climate change would substantially change the availability of fresh water. Watersheds in arid and semi-arid regions are especially vulnerable.
- It has been well established that glaciers in Latin America have receded in the past several decades (IPCC 2001, p272). Continued warming in high mountain regions could lead to disappearance of significant snow and ice surface. Because there areas contribute to river streamflow, this trend would also reduce water available for irrigation and hydropower generation.

4.10.2 Food Security

The TAR concludes that for many sub-regions of Latin America climate change will likely result in overall decreased crop yields (IPCC 2001, p272). It finds, in particular that subsistence farming could be severely threatened in some parts of Latin America, including northeastern Brazil, with implications for some of the poorest and most vulnerable sectors of the population.

Key risks from climate change include:

- Many Latin American economies rely on production from small farming systems, and these could be severely influenced by climate change.
- Extremes in climate variability (e.g. Southern Oscillation) already severely affects agriculture in Latin America. In southeastern South America, maize and soybean yields tend to be higher during the warm Southern Oscillation and lower during the

cold phase (IPCC 2001b, p714). Climate Change would be added to this background variability and could aggravate losses caused by extreme events.

- Land-use choices will be affected by climate change. For example, increasing precipitation in marginal areas could lead to an increase in cropped lands. This could have a positive effect, though in combination with other drivers (such as the continued trend to replace subsistence with market crops) there might result increasing threats to soil sustainability leading to enhanced vulnerability to climate change.
- Ranching is a major land use in many parts of Latin America. In areas subject to prolonged droughts, such as northeastern Brazil and many rangeland areas in Mexico, production would be negatively affected by increased variability of precipitation from climate change. In the case of cattle in central Amazonia, higher peak flood stages could increase losses to cattle kept on platforms (marombas) during the high-water period.
- Plantation forestry is a major land use in Brazil and is expected to expand substantially over coming decades (IPCC 2001a, p715). Climate change can be expected to reduce silvicultural yields in sub-regions where the climate becomes drier.

4.10.3 Biodiversity and Natural Ecosystems

The TAR concludes that it is well established that Latin America accounts for one of the Earth's largest concentrations of biodiversity, and the impacts of climate change can be expected to increase the risk of biodiversity loss (IPCC 2001, p272).

Key risks from climate change include:

- The remaining Amazonian forest is threatened by the combination of human disturbance, increases in fire frequency and scale and decreased precipitation from evapotranspiration loss, climate change and El Nino.
- Neo-tropical seasonally dry forest could be severely threatened by increased temperature and decreased precipitation resulting from climate change.
- Tree mortality increases at the newly formed edges of Amazonian forests - due to drier conditions. Such edges would be especially susceptible to the effects of decreased precipitation.
- Climate Change could expand the area potentially suitable for tropical forest as equilibrium vegetation types. However, the forces driving deforestation make it unlikely that such potential increases in area will be realised.
- Sea-level rise will affect mangrove ecosystems by eliminating their present habitats and creating new tidally inundated areas to which some mangrove species may shift.

4.11 Sample Annex I region: Europe

The TAR concludes that there is a very high confidence that climate change will aggravate the vulnerability of natural, social and economic systems in Europe (IPCC 2001, p270). Vulnerability to climate change in Europe differs substantially between subregions. Southern Europe and the European Artic are more vulnerable than other parts of Europe.

4.11.1 Water Resources

The TAR concludes that water resources and their management in Europe are under pressure now, and that these pressures are likely to be exacerbated by climate change. Climate change is likely to widen water resources differences between northern and southern Europe.

Key risks from climate change include:

- Flood hazard is likely to increase across much of Europe.
- Risk of water shortages is likely to increase.
- Europe's Alpine glaciers will be severely affected by climate change.

4.11.2 Food Security

The TAR concludes that in Europe agricultural yields for most crops will increase as a result of increasing atmospheric carbon dioxide concentration. However, this increase in yields will be counteracted by the risk of water shortage in southern and eastern Europe and by shortening of the duration of growth in many crops (due to increasing temperature). Northern Europe is likely to experience overall positive effects, whereas some agricultural production systems in southern Europe may be threatened.

Key risks from climate change include:

- Increased risk of water shortage in southern Europe.
- Increases in timber harvests in Northern Europe and reductions in the Mediterranean region, with increased drought and fire risk.

4.11.3 Biodiversity and Natural Ecosystems

The TAR concludes that natural ecosystems will change primarily as a result of increasing temperature and atmospheric concentration of carbon dioxide.

Key risks from climate change include:

- Permafrost will decline and trees and shrubs will encroach into current northern tundra.
- Broad-leaved trees may encroach into current coniferous areas.
- Net primary productivity is likely to increase (as a result of nitrogen deposition), but increases in decomposition (from increasing temperature) may negate any additional carbon storage.
- Diversity in nature reserves is under threat from rapid change.
- Loss of important habitats (wetland, tundra, and isolated habitats) would threaten some species
- Soil properties would deteriorate under warmer and drier climates in southern Europe.
- In mountain regions, higher temperatures would lead to an upward shift in biotic zones, posing a threat to some species.
- Timber harvests may increase in commercial forests in northern Europe, although forest pests and disease may increase.

4.12 Indicators, thresholds and the role of adaptation

The previous section has provided a sketch of some of the likely regional vulnerabilities to climate change. The next step in exploring dangerous climate change is to select specific indicators of vulnerability to climate change and to assess what would be the limit of an acceptable magnitude of the indicator.

One possible useful outcome of the HOT dialogue is to explore and generate ideas for suitable indicators of dangerous climate change; and to explore, and, where possible, identify values for thresholds that represent the limits to acceptable levels of impact in a particular impact category. The aim of this section is thus not to give a comprehensive overview of indicators, but rather to provide a framing for such an activity. Within the first phase of the HOT project we would propose the development of indicators along the lines of the following table:

Sector	Indicator	Threshold	Temporal/ Spatial Scale	Adaptation Potentials
Water Resources	Irrigation demand	50% of annual seasonal water usage	Irrigated area	Switch to crops with less water demand
Food Security /Agriculture	Productivity of a specific crop	Decrease below a threshold X	Sub-regional	Switch to crop more suited to new climate
Biodiversity/ Ecosystems	Rate of biome migration	Maximum rate of biome migration	Regional	Managed migration of tree species
	Loss of coral reef systems	Loss of X% of coral reef biodiversity	Global	None/ Managed migration of reefs

A representative set of examples of indicators was given in the box in section 3. Here these examples have been used (with some additional examples) to fill in some sample entries to the table. The entries are provided simply as examples and it is suggested that the HOT dialogue itself might further explore suitable indicators and threshold values on a regional basis.

4.13 The role of adaptation

Ultimately the realised impacts of any climate change depend crucially on adaptation: "Successful adaptation reduces vulnerability to an extent that depends greatly on adaptive capacity – the ability of an affected system, region, or community to cope with the impacts and risks of climate change. Enhancement of adaptive capacity can reduce vulnerability and promote sustainable development across many dimensions" (IPCC 2001b, p918).

Throughout evolutionary history, natural and human systems have adapted to spatial and temporal variations in climate. Many social and economic systems – including agriculture, forestry, settlements, industry, transportation, human health and water resource management – have evolved to accommodate deviations from "normal" climatic conditions, although fewer examples exist of such systems successfully accommodating the extremes of weather. This capacity of systems to accommodate variations in climatic conditions from year to year is referred to as the coping range or resilience.

The ability of individuals and social institutions to adapt to, and cope with, climate change is a function of wealth, technology, information, skills, infrastructure, institutions, equity, empowerment and the ability to spread risk. Individuals and institutions with adaptive capacity that is limited by any of these factors are more vulnerable to climate change than those who have no such limitations, just as they are also more vulnerable to other stresses. Adaptive capacity in natural systems tends to be more limited than adaptive capacity in human systems. For example, many species have limited ability to migrate or to change behaviour in response to climate change.

Adaptive measures are likely to be necessary to enhance the resilience of the ecological and socio-economic systems to projected and actual changes in climate. Adaptation to climate change can take many forms. These include actions taken by people with the intent of lessening impacts or utilizing new opportunities, and structural and functional changes in natural systems made in response to changes in pressures. In terms of adaptive actions taken by human societies, the range of options includes reactive adaptations (actions taken in response to changing conditions and *without* prior preparation) and planned adaptations (actions taken either in response to, or in anticipation of, changing conditions and *with* advance preparation). Adaptations can be taken by private entities (e.g. households or business firms) or by public entities (e.g. local, state or national government agencies).

Numerous adaptation options for responding to climate change have the potential to reduce adverse, and enhance beneficial, impacts of climate change. Yet these options will usually incur cost. This reveals a major challenge for policy makers: how do they plan these (costly) adaptive strategies against a threat that although likely to occur, is highly uncertain in the precise way that it will manifest itself? The problem is particularly acute for developing countries. Many developing nations are vulnerable to current climate hazards.[25] Most have highly variable climates and all are limited in their capacity to adapt to changes in the extremes of weather. Despite contributing little to historical greenhouse gas emissions, developing countries are nevertheless highly vulnerable to the impacts of projected climate change.[26] Adaptation to climate change is a development issue that competes for resources (or creates synergies) with other development issues, such as food security, social equity, education and health.[27]

The starting point for adaptation decisions is to identify the assets or functions at risk and to explore the possible range of impacts to which one would need to adapt. This latter activity is a complex task because it involves understanding regional patterns of climate change, the evolution of key socio-economic and biophysical components of the sector or region under consideration, and the dynamics of the impacts of changing climatic conditions on the evolving social system.

As the IPCC concluded in its latest Assessment Report, global-average temperature is projected to increase by 1.4°C to 5.8°C between 1990 and 2100. No likelihoods were attached to this range, neither was any distribution specified within this range. This creates difficulties for policymakers in prioritizing adaptation options: if all outcomes within the projected range are equally likely, all adaptation measures to address the corresponding climate change impacts should be considered equally necessary.

There have been attempts, however, within the research community to confront this limitation by estimating future climate risks and by prioritizing adaptation without first having to predict the "most likely" climate change.[28] This could be achieved by taking a risk-based approach. By identifying the triggers, or critical thresholds, which signal a state of vulnerability, it is possible to determine where this threshold is located within a range of future climate uncertainties and how likely it is the threshold will be breached.

5. Comparative Analysis of the Workshops: An Inventory of the Results

5.1 Introduction

In the first phase of the project, national and regional workshops were organized in different parts of the world. In accordance with the research protocol, surveys were sent out to stakeholders to inventarize perceptions of Article 2 of the UNFCCC. The methodology for the workshop also asked participants and other stakeholders to write their views on a few questions sent to them by the project team. These completed questionnaires were then analysed and presented at the workshops. Finally, an informal assessment meeting of the project partners was held in Potsdam to discuss the way forward.

5.1.1 The pre-workshop surveys and their substantive results

TERI in New Delhi prepared the initial questions for the questionnaire that were then used by most of the partners. The questions they highlighted included:

- Is Article 2 adequately formulated?
- When are Article 2 conditions no longer met?
- At what scale should Article 2 conditions be assessed?
- Are the three conditions equally important?
- What scientific information is most needed?
- What outcomes of climate change policies are unacceptable?
- How should mitigation and adaptation costs be mitigated?
- What controversies are to be expected?

The purpose of the questionnaire was to communicate the nature of the problem to a wide group of stakeholders and to promote their engagement in the discussion, to develop input for the workshops and to identify needs that could be then used to structure the workshop and to check if the workshop views are representative of the wider stakeholder community.

5.1.2 Response levels

The Brazilian project team sent out 700 questionnaires but received only 13 answers. The Asian survey was sent to 200 stakeholders and 27 responses were elicited. 14 responses were from South Asia, 10 from South-East Asia, 2 from the former Soviet Union countries and 1 from West Asia. Classified in terms of stakeholders, 6 responses were received from government, 8 from scientists, 10 from NGOs, 2 from international organizations and 1 from business. The African survey was sent to about 100 respondents and 20 responses were received, most of which were from NGOs and research centres and 8 from policy makers and negotiators, some from IPCC scientists. In terms of geographical representation half of the responses were from West Africa. The Annex I questionnaire was sent to 300 stakeholders of whom 38 responded. The responses were mostly from scientists (17), policymakers (15), NGOs (5) and business (1). Most re-

sponses came from Europe (19), America (8), other OECD (7), Central Europe (1) and International Organisations (3).

Although the questionnaires have been organized at national (Brazilian), continental (African and Asian) and cross-continental levels (Annex I), a similar cross-section of ideas were reflected in different parts of the world. The response to the questionnaires was about 10% which is approximately the normal response rate for such types of inquiries. People only respond when they are somehow stimulated by the subject and feel that their opinion counts. However, it appears that, particularly in developing regions, people were afraid to respond because they did not have a good understanding of the climate change issues and had actually never given much thought to Article 2, even though they were engaged in the climate change discussions in one way or another. A request to simplify the questionnaire as a means to gauge responses was made.

5.1.3 The Workshops

Four workshops were held in different parts of the world as shown in the table below.

	TERI	ENDA	COPPE	OECD
Date regional meeting	30 June, 1 July.	27 - 28 June	14 May	2-3 June
Venue regional meeting	Bangalore	Accra	Rio de Janeiro	Amsterdam
Procedural chair	Kok Kee Chow (Malaysia) or Shekhar Dasgupta (India)	Dr. Papa Cham (Gambia) and Dr. Peter Yerima Tarfa (Nigeria)	Dr. Fabio Feldmann	Dr. Joyeeta Gupta
Substantive chair	Mohan Munasinghe (Sri Lanka) or Tsuneyuki Morita (Japan)	Jean Philipe Thomas	Dr. Fabio Feldmann (with technical support COPPE)	Dr. Bert Metz
Logistical coordinator	Poonam Sahai and Tanushree Sinha	Djimingue Nanasta	André Simões and Carolina Dubeux	Marcel Berk and Wietske van den Bovenkamp

The Brazilian workshop was attended by 23 stakeholders five of which were scientists, seven researchers and three representatives from companies, three from government and three from NGOs. The Indian workshop was attended by 21 participants, the African workshop was attended by about 30 stakeholders, while the OECD workshop had … participants.

The Workshops shared some common material:

- Common introduction to the science-policy communication challenge ;
- Common background scientific papers;
- Common rules of procedure;

Although the written material was common, the interpretation was given a regional twist and regional experts presented their interpretation of the documents provided.

The workshops began with a discussion of the results of the questionnaires that had been sent out. At the workshops, the focus was on dialogue, not monologue or negotiation, listening not sermonising, equality of views and opinions, inclusion not exclusion, confidentiality and anonymity, mutual understanding and optimism. The meetings had substantive and procedural chairs to promote the discussion. For details see the Appendixes on the regional reports. All the meetings invested in ensuring that there was a common understanding of the problem and then set out to discuss the critical issues.

The following section presents an integrated cross-cutting analysis focusing on a number of issues arising from the following issues arising from both the questionnaires and the workshops:

5.2 The Practicability of Article 2

In general many stakeholders feel that it is difficult to define dangerous anthropogenic interference because it is not practical, it is scientifically arbitrary and because there is no universally accepted notion of the concept of ecosystems sustainability or because it involves first defining a desired state of economic development.

While a minority of respondents felt that Article 2 gave sufficient guidelines about how the long-term objective of the climate change regime should be articulated, many felt that in the articulation process attention must be paid to the following clusters of issues:

- The need to clarify what sustainable development[15] implies perhaps leading to articulation of alternative forms of development, the need to focus on poverty alleviation[16], and the need to clarify the relationship with sustained economic growth[17];
- The desire to focus on stabilizing temperature increase rather than GHG concentrations,[18]
- The question whether natural adaptation is desirable and instead the focus could perhaps be on ecosystem health or maintenance;[19]
- The question whether natural adaptation exclude human help for such adaptation,[20]
- The question of how equity is to be interpreted within this article;[21]
- The need to quantify the goals;[22]
- The need to include health related issues,[23] species conservation,[24] changes in land use patterns, water management and carrying capacity[25]; threat to human life due to sea level rise and extreme events, [26] access to energy, [27]

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[15] Brazilian questionnaires; but this point is also reflected in the answers given to other questions in the other regional questionnaires.
[16] Asian questionnaire.
[17] Annex I questionnaire.
[18] Annex I questionnaire.
[19] Brazilian and Asian questionnaire.
[20] Annex I questionnaire.
[21] Brazilian questionnaire.
[22] Brazilian questionnaire.
[23] Brazilian, Asian and Annex I questionnaire.
[24] Brazilian questionnaire.
[25] Asian questionnaire.

- The need to include the rate of change, irreversible impacts, distributional and scale aspects,[28]
- The need to incorporate socio-economic factors, human aspects, which all define the vulnerability of the people and their ability to adapt to the changing climate,[29]
- The need to incorporate the magnitude and direction of the policy efforts required to deal with the problem,[30]
- The need to develop monitoring instruments such as systematic observation networks, ecosystem and poverty monitoring systems,[31]
- The need to include safeguards for countries at risk from inundation,[32]
- The need to interpret Article 2 in relation to national priorities,[33] and
- The need to focus on vulnerability thresholds and indicators of individual, social and economic development; and the need to focus on risk and individual perceptions of danger. [34]

5.3 When Article 2 conditions are no longer met

The responses to the questionnaires and workshops indicate that there are a number of situations in which some stakeholders feel that the conditions in Article 2 are no longer met, i.e. that we are facing dangerous anthropogenic interference levels:

- Already, since irreversible damage is already taking place, [35]
- When the temperature increases more than 2 degrees, [36]
- When there is disruption of the west-Antarctic ice sheet, melting of Greenland, change in ocean currents, modification of regional weather systems (e.g. rain seasons),[37]
- When there are severe problems such as the 2002 drought in India, modification of ENSO patterns, floods, droughts and famines; [38]
- When irreversible damage has occurred to sensitive ecosystems;[39]
- When poverty is exacerbated,[40] and or when communities are unable to cope with local climate change,[41]
- when island states survival is affected, [42]

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[26] Asian questionnaire.
[27] Asian questionnaire.
[28] Annex I questionnaire.
[29] African questionnaire.
[30] Brazilian questionnaire.
[31] African questionnaire.
[32] Brazilian questionnaire.
[33] Asian Workshop.
[34] Asian questionnaire.
[35] Annex I questionnaire.
[36] Annex I questionnaire.
[37] Annex I questionnaire.
[38] Response to Asian questionnaires.
[39] Response to Asian, African and Annex I questionnaires.
[40] Response to Asian questionnaires.
[41] Response to Asian and African questionnaires.

- when food production or economic development is affected,[43]
- when local health is badly affected, [44]
- when unbalanced economic development vis a vis environmental conservation and social sustainability occurs, [45]
- when there is lack of proactive environmental policy at international level,[46] and
- when there is a lack of compliance with international commitments and if efforts to limit GHG emissions fail. [47]

Stakeholders felt that it was necessary to develop indicators on when dangerous thresholds have been exceeded. Some stakeholders outlined the possible negative impacts of low concentration levels. Some asked what would happen if the concentration level reached 1000 ppm (see Table).

Concentration level	Possible dangerous impact
450 ppm	2 degree Celsius above pre-industrial levels; sea-level rises beyond 1 metre
550 ppm	Greenland ice sheet melts, ecosystems will disappear, some countries will disappear.
650	
1000 ppm	??

5.4 At what scale should Article 2 be interpreted?

The bulk of the respondents felt that Article 2 needed to be interpreted on the basis of information from local through to global levels, and if necessarily on a case by case basis and/or sectoral basis. Most respondents were convinced that since impacts will be felt at local and regional levels (i.e. ecological impacts but also impacts on economic activities) these levels had to be explicitly taken into account in any determination of what is dangerous. It was also felt that equity would be a critical issue in the determination of scale.[48]

Appropriate scale also dependent on types of risks (e.g. risks to ecosystems: local-regional; risks to food production: regional-global; risks from disruption of climate system / ocean currents: global).[49] Too small scale makes it difficult to distinguish between change due to CC and other causes.[50] Appropriate scales can be bio-geographical units (ecosystem) or socio-cultural units (e.g indigenous groups) rather than administrative units (like countries). [51] In relation to ecological issues, it is asserted that the appropriate scale is global, but the interpretation of this is that all ecosystems should be saved be-

[42] Annex I questionnaire.
[43] Response to Asian and Annex I questionnaires.
[44] Annex I questionnaire.
[45] Response to Asian questionnaires.
[46] Response to African questionnaires.
[47] Response to African questionnaires.
[48] Response to African and Asian questionnaires.
[49] Response to Annex I questionnaire.
[50] Response to Annex I questionnaire.
[51] Response to Annex I questionnaire.

cause everything is interconnected. The Brazilian workshop concluded: "it is politically absurd to say that a particular ecosystem can be eliminated". [52]

Some felt that selected ecosystems and vulnerable groups should be identified as elements to focus on in relation to scale. [53] At the same time from a pragmatic perspective, it was also argued that countries are only interested in their national and local ecosystems and so each country is likely to focus on its own local priorities. [54]

5.5 Are the three conditions equally important?

The questionnaires and the workshops reveal that stakeholders face considerable difficulty in identifying the nature of the relationship between economic development, food production and security and ecosystem protection. Some felt that ecosystems should be given priority because "ecosystem adaptation is the base of the food chain and economic resources";[55] or because there are fewer adaptation options and there is greater irreversibility. [56] A range of different prioritization is suggested by some respondents, while some believe that all three are equally important. The relationship between food production and food security (probably at local level) was also emphasized. [57] For Africans, food came first. For the other regions some argued that ecosystems come first and some sustained economic development. Many felt that other aspects also need to be taken into account (see above).

5.6 What scientific information is most needed?

The questionnaires and workshops revealed that stakeholders felt that they needed information on the following research questions:

- The relation between a Party's emissions and effects;[58]
- Scenarios on regional impacts; [59]
- New technologies that are compatible with low education levels and social institutions in the developing countries; [60]
- Atmospheric carrying capacity; [61]
- Impacts on regional and local ecosystems; [62]
- Impact on human health, food, timber production, industrial development, sea level rise, desertification, sink behaviour of oceans, soil and deserts, quantification of gaps between natural and human-induced climate change;[63]

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[52] Brazilian Workshop.
[53] Response to African questionnaires.
[54] Brazilian Workshop and response to Annex I questionnaires.
[55] Responses to Asian questionnaire.
[56] Response to Annex I questionnaire.
[57] Responses to African and Annex I questionnaires.
[58] Responses to Brazilian questionnaire.
[59] Responses to Brazilian questionnaire.
[60] Responses to Brazilian questionnaire.
[61] Responses to Brazilian questionnaire.
[62] Responses to Brazilian, Asian and African questionnaire.
[63] Responses to Asian questionnaire.

- The development of statistics and indicators on what is dangerous;[64]
- The definition of valid and workable indicators for assessing local/regional vulnerability and adaptive capacity,[65]
- The definition of target-loads (e.g. % percent at high risk of X or Y; compare critical loads for acidification),[66]
- An explanation of about levels of risks from climate change at the regional level in relation to various concentration stabilisation scenarios,[67]
- About changes in risks from extreme events,[68]
- On critical thresholds for irreversible systems change,[69]
- About the climate change risks and value of losses in ecosystem functions,[70]
- About the "real" socio-economic costs of significant reductions of GHGs (not just economic modelling) ,[71]
- Methodologies to factor out (anthropogenic) CC stress component of impacted categories (e.g. food production) ,[72]
- More social science research (e.g. on risk perceptions and social tolerances, impacts on cultures),[73]
- Integrated inverse impacts analysis (from critical stress levels to likelihood of exceeding these for various emission levels (including subjective assessment of levels of confidence) ,[74]
- Better understanding of vulnerability/ danger
    - Indices of local and regional vulnerabiliy and adaptive capacity
    - Various response measures for adaptation to climate change
    - rate and level of desertification, deforestation and drought
    - Methods to quantify internal perceptions of danger and determine critical thresholds of social, physical and ecological risks of climate change
    - Approaches to assess risks in holistic manner under scientific uncertainty (integrated vulnerability and impact assessments of multiple risks),[75] and
- The development of an integrated approach for collection and assessment of information.[76]

[64] Responses to Brazilian questionnaire.
[65] Responses to Annex I questionnaire.
[66] Responses to Annex I questionnaire.
[67] Responses to Annex I questionnaire.
[68] Responses to Annex I questionnaire.
[69] Responses to Annex I questionnaire.
[70] Responses to Annex I questionnaire.
[71] Responses to Annex I questionnaire.
[72] Responses to Annex I questionnaire.
[73] Responses to Annex I questionnaire.
[74] Responses to Annex I questionnaire.
[75] Responses to Asian and African questionnaire.
[76] Responses to African questionnaire.

5.7 What outcomes of climate change policies are unacceptable?

The stakeholders indicated that three types of outcomes that are considered as unacceptable to the developing countries:

- adverse environmental outcomes such as increase in famines, natural disasters, disturbances to global/regional climate patterns, depopulation of small islands and the rise of environmental refugees and the relegation of adaptation as a secondary issue;[77]
- adverse policy outcomes for developing countries such as binding commitments that compromise the right to development, economically unfeasible implementation time frames, inequitable distribution of costs, inappropriate technology transfer, and other negative impacts on the domestic economy, no significant emission reductions by developed countries, main polluters not participating in taking action, increasing North South welfare gap and poverty in developing countries, policies that do not allocate costs and benefits in an equitable manner, policies that do not take national circumstances into account, policies ignoring the risk of high impact - low probability events, policies discouraging/impairing economic growth and putting a unreasonable burden on civil society, policies leaving future generation with unmanageable risks and costs[78]
- adverse policy outcomes for all countries which would allow unsustainable energy use, unplanned industrialization and fuel-wood consumption, excessively high per capita emissions, high carbon intensity of GDP;[79]

There was also fear about the monetization of social and cultural aspects and the excessive use of economic instruments.

5.8 How should adaptation and mitigation costs be distributed?

The developing country respondents focused on the need to further articulate the polluter pays principle and the common but differentiated responsibility principle in the Climate Change Convention.[80] In addition some mentioned the need to take historical emissions into account, [81] the need to somehow account for population (per capita principle) and population growth, capacity of countries and that there should be a mechanism for the distribution of benefits.[82] It was also emphasized by some that any mechanism developed should ensure that adaptation costs should be borne by the biggest polluters while others stated that adaptation should be covered by national governments with some help fropm outside.[83] Resources should be equally distributed between mitigation and adaptation. [84]

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[77] Responses to Asian, African and Annex I questionnaire.
[78] Responses to Asian, African and Annex I questionnaires; Asian Workshop.
[79] Responses to Asian questionnaire, Asian Workshop.
[80] Responses to Brazilian, African, Asian and Annex I questionnaires and all the Southern Workshops.
[81] Responses to Brazilian and Asian questionnaires.
[82] Responses to Asian questionnaire.
[83] Responses to the Annex I questionnaire.
[84] Responses to African questionnaire.

Currently the adaptation funds have few resources.[85] Ultimately there should be contraction and convergence.[86]

5.9 What controversies are to be expected?

The stakeholders expect a number of controversies. These include:

- The definition of sustainable development;[87]
- The articulation of principles by which Parties assume responsibility for climate change;[88]
- The articulation of a development approach which allows for growth but not at the cost of increasing emissions;[89]
- The conflict between market versus command and control instruments;[90]
- The problem of asymmetrical impacts,[91]
- The conflict between efficiency and equity;[92]
- Holistic versus reductionist interpretations;[93]
- The impact of sovereignty;[94]
- The question of imported versus endogenous technology;[95]
- The question of increased food production versus biodiversity[96]
- On adaptation and mitigation costs;[97]
- The question of which ecosystem to prioritise since different ecosystems have different resilience levels;[98]
- The question of how to deal with scientific uncertainty and access to unbiased assessment, transparency and information exchange;[99]
- The reliability of the inventories and developing baselines for GHG levels[100]
- The conflict between long-term and short-term views[101]
- Conflicts with other MEAs;[102]
- Adequacy of Annex I commitments;[103]

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[85] African Workshop.
[86] Response to the African questionnaires.
[87] Responses to Brazilian and Asian questionnaire.
[88] Responses to Brazilian questionnaire.
[89] Responses to Brazilian and Asian questionnaire.
[90] Responses to Brazilian questionnaire.
[91] Annex I workshop
[92] Responses to Brazilian questionnaire.
[93] African Workshop.
[94] Responses to Brazilian questionnaire.
[95] Responses to Brazilian questionnaire.
[96] Responses to Brazilian, Asian and Annex I questionnaire.
[97] Responses to African questionnaire.
[98] Responses to Asian questionnaire.
[99] Responses to Asian questionnaire.
[100] Responses to Asian and African questionnaires.
[101] Responses to Asian questionnaire.
[102] Responses to Asian questionnaire.
[103] Responses to Asian and African questionnaire.

- The development of commitments for non-Annex I countries;[104]
- The question of who should pay? [105]
- The question of power politics and ideological issues, [106]
- Differences about proper scale of assessing "dangerous interference", [107]
- Valuation of non-monetary impacts (ecosystems, culture) versus monetary impacts, [108]
- Lack of consensus on Sustainable Development concept and its priorities (food versus nature), [109]
- Differences about dealing with risks / scientific uncertainty (e.g. attribution of negative changes to (anthropogenic) climate change), [110]
- Differences about feasible and acceptable levels of adaptation and mitigation, [111] and
- Differences in interests between countries in mitigating CC. [112]

5.9.1 The Development of Sustainability Indicators.

The following table provides a list of sustainability indicators developed by the participants during the workshops as a first step towards defining what is dangerous. *This table inventorises the views, but does not reflect a consensus. It is also far from complete.*

Sector	Indicator	Limit	Spatial/Temporal scale	Potential for Adaptation
Water	Availability of drinking water Availability for hydropower plants Rainfall variation Average rainfall per region/concentration Pattern of Asian monsoons Net sea-level rise Amount of submerged land Frequency of flooding Change in summer run-off Frequency of droughts Regional glacier loss Ice sheet stability	In Brazil, Hydropower plants reservoirs are not allowed to have their storage capacities reduced by 20%	Water table River basins Reservoir levels	Optimisation of water use; Reducing the relevance of hydropower generation in e.g. Brazilian context Modernization of the supply & sanitation infrastructure

[104] Responses to African questionnaire.
[105] Responses to Brazilian, Asian and African questionnaire.
[106] Responses to African questionnaire.
[107] Responses to Annex I questionnaire.
[108] Responses to Annex I questionnaire.
[109] Responses to Annex I questionnaire.
[110] Responses to Annex I questionnaire.
[111] Responses to Annex I questionnaire.
[112] Responses to Annex I questionnaire.

Food safety/ agriculture	Area suitable for agriculture/inhabitation Tonnes of food produced/hectare Level of desertification Productivity of the rural zone		Regional and global Area suitable for agriculture	Expansion of land reform by providing know-how to farmers; Redistribution of areas suitable for agriculture Crop rotation Equity in food distribution
Biodiversity/Ecosystems	No. of species Number of exotic and native species Stability of the ecosystem Loss of areas with high number of endemic species Loss of charismatic flagship species (polar bear, etc.) Loss of keystone species Frequency of corral bleaching Mangroves Mountain ecosystems Water scarcity/aridity Sea level rise	At the limit, species must have preserved their migratory capacities The number of exotic species cannot be greater than the number of native species; Threat of extinction of a biome	Regional and global Ecological economic zoning	Species migration Re-adaptation and transposition of endangered ecosystems
	Disintegration of the Antarctic Ice sheet Permafrost thawing Weakening of the thermohaline circulation Glacier retreat		Global level	
	Extreme events Frequency of storms Frequency of surges Intensity	Increased frequency/intensity People affected Economic loss		
Health	<u>Direct</u> Morbidity Mortality <u>Indirect</u> Risk exposure Environmental risk	Establishing limits that foresee increases in health problems in e.g. Brazil is unacceptable	Local, provincial, national, regional and global	Education campaigns Identification of new vaccines and medications Combatting vectors that transmit disease Improving basic sanitation infrastructure
Socio-economic	Food security Food shortage Self-sufficiency Crop migration Environmental refugees			

	Crop productivity
	Loss of land due to sea-level rise
	Loss of community welfare
	Reduced development capacity
Others	Pests
	Ecosystem nutrient rates
	Habitat fragmentation/ ecosystem adaptability
	Rate of climate change
	Temperature

The Annex I workshops concluded that in order to define an effective list of criteria, we would need to identify:

- Criteria, as mentioned in the table above.
- Indicators for measuring the criteria such as number of people seriously affected, income effects and damage, impacts on HDI and the impacts on the built environment;
- Criteria for determining the appropriateness of the criteria such as measurability, predictability, reliability, attributability, transparency, and public appeal, and
- Threshold levels such as early warning levels, maximum acceptable levels and no-go levels.

5.9.2 Clustering of Views

The following section attempts an analysis of the different perspectives of the stakeholders.

There was general consensus among all the participants on the need to focus on Article 2 since it is the basis for all future negotiations.[113] This was especially important given that many negotiators tend to overlook the long-term goal because of short-term pressures.[114]

There were those who felt that sustainable development is broad enough to cover all the concerns of the developing countries; while others felt that it was too vague and therefore would end up not covering anything. [115]

- This would imply that there is urgent need for a short one-page articulation of the relationship between sustainable development and climate change concept so that there is a common starting point for the global dialogue.

There were concerns that the way ecosystems were included it was unclear if all ecosystems should be protected for themselves and whether the ecological services they provide to humans was included. There was general consensus on, in any case, including the

[113] Brazilian, African Workshop.
[114] African Workshop.
[115] Brazilian and African Workshop.

latter concept in the articulation of this concept. [116] Maintaining all ecosystems may be a valuable goal but not feasible. [117]

- This would imply that there is urgent need for a short one-page articulation of the ecosystem concept so that there is a common starting point for the global dialogue.

There were concerns about whether food production or security was implied by Article 2 and whether food production and security at global level is acceptable or whether regional and local security are more critical issues. Another issue was whether technology can address this problem. [118]

There were conflicting views about the how the three issues – ecosystem, food and sustainable development relate to each other in the Article 2 and while African prioritised food security, others were not sure which led to which outcome and if there was a linear relationship between the three.[119] More information on the relationship between the three could perhaps help people make informed choices.

In any case it was felt that the focus on sustainable development, ecosystems and food should also include human health[120]

Further, while most felt that equity should be the guiding principle in interpreting the Article, one must also take cognisance of the political realities. [121] Thus while many felt the polluter pays principle should guide the negotiations, others felt that this would be an impossible item to negotiate. [122]

- This could imply that a separation needs to be made between what countries want, and how they actually negotiate it given the political context. Mixing the two approaches may be an unproductive way of dealing with the issues. Some clarification and discussion of this could possibly add to the next round of dialogues.

There were concerns that the central challenge of poverty was not being adequately resolved in the discussions.[123]

- This could imply the need to summarise whether a poverty mainstreaming approach in the climate change agenda could yield results (link up with the poverty and climate change discussions currently taking place).

There was convergence in the developing country workshops on what was unacceptable outcomes of the negotiating process, but these views differed somewhat from the views of the stakeholders in the Annex I workshop.

There was fear that impacts at national level would be the driving force for action and that this could be a major bottleneck in the process.

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[116] Brazilian Workshop.
[117] Brazilian Workshop.
[118] Brazilian Workshop.
[119] Responses to the questionnaires and the Workshops.
[120] Brazilian Workshop.
[121] Brazilian Workshop.
[122] Brazilian Workshop.
[123] African Workshop.

- However, this could be dealt with by listing key unacceptable impacts in each region and then seeing what concentration level these unacceptable impacts are correlated to. This might help to find common ground.

Some critical issues are: if national priorities are to be given priority as developing countries want, then this could be a two-edged sword that allows the developed countries to also prioritise domestic issues. Is this what the developing countries want?

Another issue was the discussion on sustainable development. On the one hand stakeholders sought some clarification of this term and on the other hand, the African stakeholders concluded that they did not want a check-list of what is sustainable.

The Brazilian workshop revealed essentially two ideal typical types: The Counter-realist[124] or developing country realist who argues for a legal and fair solution to global problems based on the principle of polluter pays and the precautionary principle and the Realist who says that since this argument is unacceptable to the developed countries, a different approach should be adopted. The African dialogue concluded that there were five types of perspectives – the Doubting Thomas (how is it going to work), the Speedy Gonzales (what can we do to make it operational), the evaluator (how do we make the discussion relevant and effective), the pessimist (we are too far behind in any case to address the problem and be sustainable), the optimist (we have already achieved so much!).

5.10 Workshop and Project Evaluation

5.10.1 The Workshop Evaluations

The following section briefly sums up the evaluation of the workshops.

The Brazilians evaluated their workshop very positively in terms of exchanging ideas, knowledge and personal viewpoints and learning from each other. They feel that they have now identified a team of committed people who will be willing to work on this issue for some time together to further articulate the key issues involved. However, industry was inadequately represented in the group. Despite the absence of industry, there was a positive and constructive sphere which led to effective learning and brainstorming processes. In terms of process, all participants felt that were given a chance of communicating their perspectives, and 80% felt that others were able to understand what they had said. 30% of the participants felt that their positions on some issues had shifted as a result of the discussions. All participants felt that they identified common ground with other actors which they had not anticipated. All participants felt that they had acquired new scientific information and 50% of the participants said that they had also learnt a lot about health, politics and international power relations. 70% of the participants felt that consensus domestically was possible and at least existed in relation to information needs. 60% of the participants anticipated major disagreement nationally and internationally on the issue of the distribution of costs. Only 10% of the participants felt that there was agreement regarding the issues on which there was disagreement. Two types of disagreements emerged: the first is in relation to whether negative impacts on Brazilians are

[124] Using definitions from Gupta 1997.

acceptable or not (one group said no- the other group said look at the power politics); and the other was on the accuracy of new climate change models.[125]

The Asian Workshop concluded that they had two days of rich dialogue and intensive debate. However, there was limited participation from the business sector and the policy making sector. The Workshop also focused on the need to develop sub-regional perspectives given the vast differences within the Asian region. The Participants concluded that such a Dialogue process could contribute to further development of the controversial issues that Article 2 raises.

The African Workshop concluded that they needed to move the discussion further through communicating results to outsiders and through an e-dialogue. The results of the survey showed that participants are not well informed about what is available and that they learnt a lot through the process. The evaluation of the workshop revealed that most participants were able to express their views freely, some hoped that they had been understood by others, while one was quite sure that he was not understood by the others. Some participants changed their position because they received more information while others were not convinced because of the lack of clarity in the arguments and the need to repeat African positions even if they were rhetorical. The participants argued that factors that influenced a change of position included:

- The realisation of the need to work together at national and international level,
- The need to adapt development policies to match international commitments,
- New and additional information, and
- Arguments from other participants.

During the process some parties realised that they had common grounds with others which they had not previously identified especially in relation to the relationship between climate change, commerce and security, and adaptation.

The Annex I stakeholders were very positive about the content and structure of the dialogue. Most told that they had learned a lot through the dialogue process though their positions may not have changed. They recommended longer dialogue sessions, smaller breakout groups and a little more structure.

5.10.2 The Future of HOT

The Workshops recommended that the project continue on the next phase; that there was enough support for both the focus and the methodology adopted to justify such an outcome.

These suggestions have been elaborated in a detailed project proposal for Phase II.

Some of the additional topics proposed for the next round were:

- To discuss article 2 in further detail at the global round of negotiations since climate impacts will most likely hit developing countries much harder than the developed countries,[126]

[125] Brazilian Workshop.
[126] Brazilian Workshop.

- How to allocate the costs related to the reduction of greenhouse gas emissions and to the adaptation to climate change under the mantle of equity among nations; South-South and North-South discussions? [127]
- Means of improving social and market acceptability for non-fossil technologies? [128]
- To create opportunities for discussing positions at a sub-regional level but possibly across continents, [129]
- The provision of answers to the questions raised in Phase 1, [130]
- The impacts of trade on climate change, [131]
- The relationship with WTO and other MEAs, [132]
- National security, [133]
- Public health and population control, [134]
- Public opinion, [135]
- Urban and local issues and linkages with climate change, [136]
- The Brazilian proposal on burden sharing, [137]
- Distribution of adaptation costs among developing countries, [138]
- Capacity building in DCs on science, assessment, policy analysis and negotiations,
- Mobilization of local resources, [139]
- How can DCs ensure sustainable development without slowing down their growth? [140]
- Vulnerability of Africa – what is dangerous for Africa [141]
- New mechanisms for promoting cooperation [142]
- The role of justice in determining dangerous climate change risks, [143]
- The possibilities of science to help define relevant and usable indicators, [144]
- What levels of adaptation are feasible and acceptable, [145]
- How risk theories can help in understanding Art.2, [146]
- Appropriate ways to make Art. 2 more meaningful for discussing post-Kyoto policies, [147]

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[127] Brazilian Workshop.
[128] Brazilian Workshop.
[129] Brazilian Workshop.
[130] Annex I workshop.
[131] Responses to African questionnaire.
[132] Responses to Brazilian questionnaire.
[133] Responses to Brazilian and African questionnaire.
[134] Responses to Brazilian questionnaire.
[135] Responses to Brazilian questionnaire.
[136] Responses to Brazilian and African questionnaire.
[137] Responses to Brazilian questionnaire.
[138] Responses to African questionnaire.
[139] Responses to African questionnaire.
[140] Responses to African questionnaire.
[141] Responses to African questionnaire.
[142] Responses to African questionnaire.
[143] Annex I questionnaire and workshop.
[144] Annex I questionnaire and workshop.
[145] Annex I questionnaire and workshop.
[146] Annex I questionnaire and workshop.

- How to involve all relevant stakeholders (incl.. indigenous peoples) ,[148] and
- How to account for regional differences in global dialogue. ,[149]
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[147] Annex I questionnaire and workshop.
[148] Annex I questionnaire and workshop.
[149] Annex I questionnaire and workshop.

6. Conclusions and Recommendations

6.1 Major conclusions

At the end of the first phase of the HOT project, the project team concluded that they were satisfied with the outcomes of the first phase. Most participants in the process became very stimulated by the complicated scientific and value dimension of Article 2 and the need to develop new instruments for communication at a global level on these complex issues. Some of the key conclusions of the first phase are:

The focus on Article 2

There was general consensus on the need to focus on Article 2. It was agreed that political agreement was possible in 1992 by keeping Article 2 unclear and open to interpretation; but any future steps will need a further articulation of this Article.[150] This leads to the implication that any attempt at articulating Article 2 will be an extremely politically challenging task and that high quality regional preparation and global dialogue as a precondition for negotiation are a must. In fact, the first phase of our dialogue reveals that most negotiators get so involved in the nitty gritty details of negotiating short term goals on the basis of narrow national interests, that they lose sight of the long-term objective and what it implies for national commitments. It is therefore necessary to look beyond shorter-term imperatives in order to address this objective and contribute towards a sound and equitable long-term solution to the challenge of climate change.

Is climate change a serious problem?

In all the developing country workshops, there appeared to be some doubts as to the severity of the potential impacts of climate change for the worlds' developing countries and there was a strong request for scientific studies that would help predict the magnitude of the impact and its consequences.[151] This was somewhat in sharp contrast with the Annex I workshop where there was little doubt that developing countries would be very hard hit. The developed country questionnaires revealed that many felt that we were already experiencing dangerous climate change. [152] The impacts on developing countries were seen to be primarily in relation to small island countries and possibly desert regions, as well as in the hydrological systems and food security worldwide.

Can environment and development be dichotomised?

Many stakeholders in the developing countries onderline the need that these countries should focus on development and that environmental issues should be considered in this context. [153] Given the current status of the problem, the magnitude of the costs to reduce the concentration of GHG in the atmosphere to a safe level and the political difficulties

[150] Brazilian Workshop and Annex I questionnaire.
[151] Asian, African and Brazilian Workshops.
[152] Annex I questionnaire.
[153] Brazilian, Asian, African Workshop.

to implement the required measures, there will be need to count on technology in order to minimize the problem. The argument was that new technologies will substitute for some the functions of the environment. This leads to the question: Can developing countries afford to dichotomise ecosystem protection and development in the context of Article 2? Further, can new technologies actually imply a reduced dependence on the environment? How can climate change be mainstreamed? In the Asian dialogue, it was recognised that generating awareness among stakeholders about potential impacts and their roles is the route to influence decisionmakers since they are guided by public perception. Integrating climate change policy with the development framework was regarded as the key, as any society will define Article 2 in the context of its own sustainable development priorities.

The practicability of Article 2

The discussions concluded that Article 2 could be helpful in defining climate policies, but needed to be further elaborated so that there is common understanding of:

- What is not an acceptable outcome of Article 2;
- When Article 2 conditions are no longer met;
- Common starting points for discussion and elaboration on the key terms in the Article and the appropriate scale for these terms;
- Identifying information needs to help the articulation process.

Controversies

There was some divergence about how serious climate change is as a problem, how "dangerous" should be defined, how priorities should be set, the risk of reductionist interpretations of Article 2 and that the fear that historic responsibilities would not be taken into account. The first step in dealing with the controversies is to name them and to see if we can develop a common conceptual document in relation to these controversies and then move the dialogue further from there.

Finding common ground through local impacts

The participants asked for information regarding how concentrations of GHGs affect ecosystems, how they impact on local human health and timber production, how they affect desertification; what the roles of oceans, soils and deserts are as sinks of greenhouse gases; how much of the emissions are human induced; the development of indices of local and regional vulnerability and adaptive capacity, various response measures for adaptation, methods to determine thresholds for risks, and approaches to assess risks in a holistic manner. If it is possible to identify local impacts that occur at the same concentration level – it may be possible to find common ground across regions. If both rich and poor countries believe that locally they have cause to concern, they may agree that GHG levels beyond a certain concentration are unacceptable.

Finding common ground through the development of Indicators

There was general consensus that developing indicators for what could be dangerous is a useful way forward. There was also a need to create a procedure for defining indicators.[154] Furthermore it was considered necessary at this stage to develop a set of criteria to prioritise the indicators. It was also considered useful to relate different levels at GHG to the set of indicators at the global and regional level.

Finding common ground through understanding the importance of values and principles in international law and relations

The major question that was raised in all the dialogues was how mitigation and adaptation costs should be distributed among countries and what criteria should be used to do this. Several criteria were mentioned in the different dialogues and number of principles were put forward. The legal viability of these norms needs to be verified through legal and political science research.

Social and scientific learning

Most of the participants in the developing country workshops had a very little notion of what a discussion of Article 2 would involve. Many felt intimidated by the questions in the questionnaire and were afraid that they did not have enough knowledge to deal with them. However, by the end of the workshops, most felt that even if they had not changed their position, they had learnt considerably about the various dimensions of Article 2. But even in the OECD workshops, participants felt that they had been exposed to a rich learning experience.

Self-selection of participants

In all the national, regional and cross continental workshops it has become more than apparent that some kinds of stakeholders are more willing to participate than others. Very few participants from business and industry responded positively to the invitations to participate. This indicates that either they do not see the determination of long-term goals as something they have any competence in, or simply because of lack of interest. This lack of interest could stem from the fact that the issues at stake in the dialogue are not considered to be directly relevant to the work of these stakeholders. The non participation of these stakeholders also implied that only those who were either very interested or motivated in the issue participated. The question is: Is it a structural weakness of the approach that the groups turn out to be groups of like-minded people? On the other hand, there were enough differences of opinion in all the workshops to still make it worthwhile to continue the discussions. Yet, this is a structural weakness and the partners will have to devise ways to include uninterested stakeholders with large stakes to join the process. The dialogue will hopefully provide ideas and learning that, eventually, will influence the many parties who are not interested or are perhaps even hostile to climate change negotiations. This in itself is a good justification to continue the dialogue cycle further since the more chance people have to gain and share information, the more likely it is that ideas will sink in and extend to a wider circle. It was also noted there were no in-

[154] Asian Workshop.

digenous participants or participants who were not experts or professionally interested in climate change. This was a weakness that also needs to be addressed in order to strengthen the dialogue.

6.2 Recommendations

The major recommendations that flow out of this research are:

Continuation of the dialogues

There was general consensus on the need for national and regional workshops to help participants prepare for global workshops on this issue. Initially developing country participants felt especially uncomfortable about discussing issues to which they had given little or any thought. Many now feel that they have a much better idea what the key issues are and that they will be in a better position to enter into discussions at a global level, before reflecting again in regional groups. The dialogue, unlike a workshop, gave the participants an opportunity to focus on what they understand from the issues, to identify the sort of information they need, and to articulate their underlying values.

Provide assessments of impacts at regional level

Much more detailed information should be made available to the developing country respondents not so much on the effects on small island states, since this appears to be internalized, but on general environment and ecosystems of the larger countries in the world and how this can affect their economy. For example, according to an expert[155] stabilization at 370 pp, would already intensify El Niño and lead to severe consequences for Latin America; something not reflected in the IPCC TAR reports.

Initial information needs

The following section is based on an analysis of the information needs arising from the questionnaires, the workshop discussions both directly and indirectly.

The information needs can be classified into four categories:

- Information needs on impacts
    - Anthropogenic contribution to climate change and a quantificationof gaps between natural and anthropogenic climate change; [156]
    - Information on the correlation between GHG concentration levels and El Niño;[157]
    - Information on the relationship between development, food production and ecological resilience;
    - Information needs on regional and local health impacts; [158]
    - Regional impacts on ecosystems, their vulnerability and their capacity to adapt;[159]

[155] Brazilian Workshop.
[156] Brazilian Workshop.
[157] Brazilian Workshop.
[158] Brazilian Workshop.

  - Information on the impacts of sea level rise and desertification (see footnote 8);
  - How can non-monetary indicators be developed, scientifically justified and defended in the international arena?;
  - Can a poverty mainstreaming approach be beneficial in interpreting Article 2?

- Information needs on new technologies
  - Can genetic engineering provide a solution to food shortage and how will this affect developing countries?[160]

- Information needs on articulation of certain terms
  - Relationship between sustainable development and climate change; [161]
  - Ecosystems to adapt naturally; [162]

- Development of models
  - Development of indicators and threshold levels; building on the ideas that emerged at the workshops;
  - Policy guidelines on how the information should be communicated to non-scientists; [163]
  - Policy guidelines on how to deal with scientific uncertainty and how to articulate the precautionary principle;[164]
  - Policy guideline on a process to develop indicators;[165]
  - Development of indicators on sustainable development (link up with the South-South-North project on this subject). [166]
  - Methods to quantify internal perceptions of danger and determine critical thresholds of social, physical, and ecological risks from climate change (Asian Workshop).

Need for value related research

There was considerable discussion on the conflicts in values between countries and the role of values in international relations and law. There was dissatisfaction with the notion that national interests alone determine how countries take responsibility for their ac-

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[159] Brazilian Workshop.
[160] Brazilian Workshop.
[161] Brazilian Workshop.
[162] There was some discussion of what is natural adaptation?[162] Ecosystems could possibly adapt in such a way that global food production is not disturbed but regional food and water production is so badly affected that countries lose their basic food security. Did the concept of natural adaptation also take into account the issue of ecosystem services?
For most workshop participants, maintenance of the ecosystem and its services was the vital feature since this would influence food production and economic well-being.[162]
[163] Brazilian Workshop.
[164] Brazilian Workshop.
[165] Asian Workshop.
[166] Brazilian Workshop.

tions. In many of the workshops, it was emphasized by some of the participants that equity principles in Article 3 should determine the way Article 2 is interpreted. This calls for more value related research in international law and politics.

Procedural aspects

- It was decided to continue with the pre-dialogue questionnaire process because this helped to involve and inform a larger group of social actors about the problem and to gain access to their views. However, in the following round, the questionnaire will be simplified and possibly include closed questions based on the information received.
- It was also felt necessary to find ways to make the process more attractive to other parties such as industry and policy makers from different sectors so that they would also be willing to engage in the discussion and bring their perceptions to the discussion.
- Since in some of the workshops, people were torn between what they saw as fair and what they saw as negotiable and reasonable, possibly in the future rounds of the dialogue we should try and split the two notions and see if that yields ground for more cooperation.
- It was decided to continue keeping the dialogues as distinct and separate from the negotiating process.
- Stakeholders recommended long working sessions, smaller breakout groups and enhanced interaction into science.

6.3 Initial follow-up steps

As an initial follow-up step, the HOT programme team submitted a pre-proposal to MISTRA in Sweden and was short-listed for submitting a proposal. This proposal has been submitted to MISTRA and we are now awaiting the outcomes of that discussion.

Another follow-up proposal has been submitted by some members of the HOT programme to the Dutch NRP programme to undertake a dialogue within the Netherlands. This proposal is also under discussion.

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