

**REPORT OF THE WORKSHOP
"ON ASSESSING WINNERS AND LOSERS
IN THE CONTEXT OF GLOBAL WARMING"**

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I. INTRODUCTION TO THE REPORT

In recent years, the issue of climate change has rapidly advanced to the top of national and international scientific agendas. As this issue has gained in importance, a number of scientists and policymakers have commented on advantages and disadvantages that might accrue to nations and regions if the climate changes in coming decades. These comments have varied from the extreme – that everyone will win or that everyone will lose – to suggestions that certain nations, sub-national regions, or economic sectors may derive relative advantages or disadvantages. Some examples are as follows:

... although the available information shows that moisture conditions in a number of regions have already deteriorated due to global warming, it is probable that beginning with the first quarter of the 21st century the moisture conditions will improve everywhere. This casts doubt on the expediency of carrying out very expensive actions aimed at retarding or terminating global warming during the nearest decades.

–M. Budyko, 1988

The warming is truly global. The drought is planet-wide. There are no places to escape to, no ideal new locales for transplanted agriculture. In the long run, there are no winners from global warming. Everybody loses.

–C. Sagan, 1990

Because the warming would not be uniform over the surface of the earth, it would probably produce both winners and losers among regions and nations.

–R.M. White, 1990

Such generalizations about gains and losses, advantages and disadvantages, have not been based on adequate scientific assessments of possible costs/benefits or advantages/disadvantages over varying time-scales.

In a first formal attempt to address the methodological approaches and constraints on their utility for the objective assessment of advantages and disadvantages associated with a climate change, a workshop “On assessing winners and losers in the context of global warming” was convened in Malta on 18–21 June 1990. The

workshop was organized by the Environmental and Societal Impacts Group (ESIG) of the National Center for Atmospheric Research (NCAR), with support from the United Nations Environment Programme (UNEP) and the U.S. National Science Foundation (NSF). The overriding objective of the workshop was to stimulate discussion of the methods that might be used for, and of the constraints on, making objective assessments of the societal impacts that may derive from climate change at all levels of social organization from the local to the international levels.

The 21 participants in the workshop (only one invited participant was unable to attend) were drawn from Africa, North, Central, and South America, South Asia, Western and Eastern Europe, and the USSR. As can be seen from the following list (complete addresses can be found in Appendix 2), they represented a great diversity of expertise which included biology, economics, education, geography, international law, meteorology, philosophy, physics, political science, sociology, and policymaking at sub-national to international levels (see Appendix 3 for brief biographical sketches of each participant).

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Anthony Borg Global Issues Section, Ministry of Foreign Affairs, Malta
George Busuttil Political Division, Ministry of Foreign Affairs, Malta
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Helen Ingram Political Science, University of Arizona
Dale Jamieson Environmental Ethics, University of Colorado
Wangari Maathai Biology, Green Belt Movement, Kenya
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- Klaus M. Meyer-Abich** Policymaking, Philosophy, FR Germany
- Martin F. Price** Geography (Rapporteur)
- Philippe Roqueplo** Sociology, Ecole des Hautes Etudes, Paris
- Carmen Schlosser** World Climate Impacts Program, UNEP, Kenya
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- David G. Streets** Policy & Economic Analysis, Argonne National Laboratory
- Igor Zonn** Water Resources & Desertification, USSR

Willy 'N Ethel



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II. OPENING SESSION: 18 JUNE (morning)

The workshop was opened by Michael Glantz, Director of ESIG (see Appendix I for complete workshop agenda). He noted that the issue of assessing winners and losers had been neglected in formal discussions about the implications of climate change and that it was an important issue of common concern and of increasing interest. He stated his belief that it needed to be addressed openly, objectively, formally, and internationally.

He then introduced the Hon. Guido de Marco, Deputy Prime Minister and Minister of Foreign Affairs and Justice of Malta, who formally welcomed the participants on behalf of the Republic of Malta. He described the topic of the workshop as one of global significance. He noted that the issue of global climate change was one of great concern to Malta. As stated in United Nations (UN) Resolution 43/53, proposed by Malta and adopted unanimously by the General Assembly on 6 December 1988, climate change is a common concern of humankind. Understanding of the climate system has grown in recent years, particularly through work undertaken by the UN Environment Programme (UNEP), the World Meteorological Organization (WMO), and the International Council of Scientific Unions (ICSU). Some of the important landmarks in this international effort include the 1979 World Climate Conference and the establishment of the World Climate Program, and the UNEP/WMO Intergovernmental Panel on Climate Change (IPCC), as well as the forthcoming Second World Climate Conference.

Malta has been in the forefront of increasing international awareness of the issue of climate change and its potential effects on present and future generations, especially through the work of the IPCC on response strategies and elements for inclusion in a Framework Convention on Climate. The activities of the IPCC will culminate with the Second World Climate Conference, to be held in Geneva in

November 1990. In the discussions of the IPCC working group on response strategies, a dominant concern has been that economic development of developing countries may be hampered both by the adverse effects of climate change and by the need to institute policies to prevent or limit them. Delegates from developing countries have stated that, since activities in developed countries have been the primary causes of climate change, these countries have the primary responsibility for combating climate change and its adverse effects and should assist developing countries through transfers of technology and financial resources.

UN Resolution 44/207, adopted on 22 December 1989, states that the best attempt for a solution to climate change will be a Framework Convention on Climate. It is hoped that this will be ready for signing at the 1992 UN Conference on Environment and Development to be held in Brazil. The convention would be further reinforced by protocols which are presently being drafted. These various activities, and statements from many recent meetings, show the centrality of climate change on the global political agenda. The deliberations of this workshop should provide a positive contribution to this effort.

With the conclusion of Deputy Prime Minister de Marco's opening speech, the workshop chairman then called on the UNEP representative, Mr. Anastasios Diamantidis, to address the workshop participants. Mr. Diamantidis reminded participants that climate change presents humankind with its greatest environmental challenge. Scientific research continues to increase our knowledge of changes in the climate system, particularly with regard to emissions of greenhouse gases. However, there is considerable uncertainty about the future paths and, particularly, consequences of climate changes and their spatial distribution. In spite of this uncertainty, UNEP considers that the potential impacts are too great to ignore. For example, sea level rise which would accompany a global warming would threaten a significant part of the global population, as well as major urban centers, leading to

extreme disruptions of economic and social systems. These sea level rise impacts might be exacerbated by stronger hurricanes and typhoons. He also noted that climate change is likely to have adverse effects on forests and food supplies, a critical issue as the global population increases.

Human-induced environmental catastrophes have happened in the past, and are likely to occur in the future. Most recent ones have included the release of radionuclides from Chernobyl and stratospheric ozone depletion, events with universally adverse consequences. Yet, the consequences of climate change could be even worse. They must be put in the context of present-day climate impacts, such as losses of agricultural production and human life from droughts and storm surges. To a certain extent, these impacts are related to existing inequalities which need to be corrected through actions based on an improved understanding of the interactions of climate and society. At the same time, decisive action is required to assess as soon as possible likely risks of climate change for subsequent generations and to minimize these risks for their benefit.

It is UNEP's position that we should definitely try to limit climate change. To achieve this goal UNEP has been working toward the development of an international agreement on stabilizing the emission of greenhouse gases through changes in energy usage, energy efficiency, and rational forest management. This will require cooperation both among and between developed and developing nations, and agreement from developed countries to provide appropriate technology and financial and technical assistance so that developing countries are not limited in their options for development. A number of important actions have already taken place or are foreseen. In Europe, for example, the European Commission has proposed that countries should stabilize CO₂ emissions at present levels by 2000. This proposal has been supported by West Germany, Denmark and the Netherlands. On a global scale, the reports of the IPCC will be presented at the Second World Climate

Conference. This may lead to actions to stabilize climate change, prepare for its impacts, and provide assistance to developing countries. Environment ministers at the conference will also decide on the path towards a global agreement on climate and associated protocols. It is hoped these will be ready for adoption at the 1992 UN Conference on Environment and Development.

Research supported by UNEP considers climate variability and climate change equally, with the aim of promoting understanding of current and future climate impacts in order to assist people to use climate, as well as information about it, to their advantage and to minimize climate's adverse impacts. These are central issues for this workshop. In particular, it is important to consider that a nation's capacity for anticipatory response depends more on its political, economic and social characteristics than on its physical characteristics. As the first formal examination of the issue of gains and losses that might result from climate change, the greatest value of the workshop will be to provide a step toward rational examination of the consequences of climate change.

Michael Glantz concluded the opening session by defining the aims of the workshop: to discuss methods available for, and constraints on, making objective assessments of the societal impacts that may derive from climate change. He emphasized that, while it was not a purpose of the workshop to identify individual countries that might benefit or suffer from climate change, issues of wins and losses might be considered in terms of specific regions, economic sectors, or populations. Two critical issues in the assessment of winners and losers are that their identification will depend on the methodologies used for assessment, and that they are likely to change over time.

III. GENERAL DISCUSSIONS: 18 JUNE (afternoon) AND 19 JUNE (morning)

Following the opening session's official formal presentations, the participants were asked to introduce themselves and to inform the others of their research interests and activities. Brief biographical information about each of the participants can be found in Appendix 3.

Glantz then proposed that the tentative agenda be discussed and, as necessary, amended. This generated wide-ranging discussions on the issues of central concern to the workshop. These were listed in the tentative agenda as follows:

- *What do we mean by change?*
- *Is every change from the present necessarily a bad change?*
- *Absolute change, relative change, rates of change.*
- *Changes in variability and extremes.*
- *What constitutes a win in the climate change context?*
- *What constitutes a loss?*
- *Are there examples of climate-related wins and losses in today's global climate regime?*
- *How can wins and losses be measured? Regionally, nationally, globally?*
- *Can wins and losses be aggregated?*
- *What is the relationship between perceptions of wins and losses and the reality of wins and losses?*
- *Who wins if no action is taken AND the global climate regime remains as it is today?*
- *What might today's climate-related winners do to compensate today's climate-related losers?*
- *How does one deal with intergenerational equity issues?*
- *How does one deal with intragenerational equity?*

These general discussions are summarized in this section.

The climate changes of direct concern to this workshop are regional climate changes that would accompany changes in the chemical composition of the atmosphere, resulting from human activities.

The issue of wins and losses (also referred to as gains and losses or advantages and disadvantages) is apparently highly political because it is perceived to relate directly to the prospects for achieving consensus on a convention to stabilize climate. It also draws attention to the problems and prospects of existing economic development plans of developing countries. The issue also generates debate about how to share responsibility for the potential environmental and societal impacts of a major human-induced alteration of the global atmosphere.

There is widespread consensus in the scientific community that the chemical composition of the atmosphere is changing. Yet there is great uncertainty as to the resultant rates and types of changes, such as regional changes in temperature, precipitation, and soil moisture, and the environmental and societal impacts of these changes. Scientific research is unlikely to eliminate the uncertainty for some of these topics or even to reduce it significantly in the near future. Moreover, considerable scientific research is required to begin to assess whether environmental changes will be gradual or steplike and to what degree some of them may be reversible. If the conclusions of a large part of the scientific community are correct, global climate change will have considerable consequences for humankind.

Participants acknowledged that some assessments of the potential impacts of climate change for regions and economic sectors within nations have already been made. However, many of these assessments are preliminary, are limited by the uncertainties about possible changes in physical systems, and have in general not considered secondary effects or interactions. Nonetheless, some suggestions about potential changes, such as increases in climate variability and the frequency of extreme events, do exist. Studies relating to such potential changes in regional climatic

characteristics can be used to assess the vulnerability of contemporary societies to certain aspects of climate change and, hence, to suggest possible responses to reduce societal vulnerability to the regional impacts of climate change.

With the current regional distribution of global climate, one could argue that different nations, sectors and groups have identifiable relative advantages and disadvantages. These result from a combination of climatic factors (such as climate variability and the frequency and intensity of extreme meteorological events) and a wide range of unique (by country, region, sector or group) economic, social, and political factors that must be taken into serious consideration in any analysis. Such differences, attributable to climate factors (e.g., recurrent droughts or floods), are likely to persist, although the relative positions of those affected directly as well as indirectly might change. Furthermore, if such differences become extreme, they can lead to population movements by the disadvantaged (i.e., generating environmental refugees) and to conflict within national borders or across them.

Gains and losses at all levels of social organization, from local to international, may result directly from climate changes themselves or from human responses to those changes. While there are several spokespersons for the extreme views (i.e., that all will win or all will lose), in all cases of change (both relative and absolute) some will benefit, while others will be adversely affected. Some nations, sectors and groups may have the ability to respond or adapt to climate change, turning this to their future advantage. Participants felt it was important to underscore their belief that for any group, relative advantages and disadvantages are likely to change over time and that what might appear to be an advantage from climate change in the near term may in the long run turn into a disadvantage, and vice versa. Because of this temporal dimension, the participants preferred the terms 'advantaged' and 'disadvantaged' to 'winners' and 'losers' because the latter implies that there is an identifiable and final end-point.

Objective assessments of gains and losses may be undertaken from a variety of perspectives (economic, political, cultural, ethical, etc.). Different perspectives will likely highlight different advantages and disadvantages (even for the same country, region, sector or group). With traditional economic methods, the relative weights of benefits and costs depend on the discount rates chosen for analysis. This approach is inappropriate for assessing advantages and disadvantages from climate change several decades into the future because, over this time period, all future costs and benefits are calculated as being insignificant. In addition, cost-benefit analyses typically consider only marketable goods. For example, effects on unmanaged ecosystems are not measured, even though the maintenance of these resources may be critical to long-term sustainable regional development. Thus, climate change occurring several decades into the future raises many issues that have been particularly troublesome to economists; external factors that are unknown, discount rates, obligations to future generations, and valuation of non-market "goods." A corollary to these issues is that quantitative (e.g., economic) methods alone are inadequate for a reliable assessment of advantages and disadvantages resulting from climate change in the long term.

Participants also noted that much more attention must be paid to issues of intergenerational equity. This requires that crucial non-quantifiable factors and values be incorporated into regional impact assessments.

Even with current levels of uncertainty about global climate change and its regional impacts, actions can be taken by decision makers at international, national, regional, and local levels to develop policies focusing on the known human activities that lead to climate change: e.g., improving energy efficiency and rational forest management. These topics are already being considered as subjects for protocols on which an international convention on stabilizing global climate can be developed. Participants, however, felt that the possibility of a widely supported international

agreement on a framework convention by 1992 (when the Environment and Development Conference will be held) was limited. The processes leading to the Law of the Sea, the Vienna Convention, and the Montreal Protocol are being used as guides in a continuing process in the evolution of international law. It was noted that UN negotiations on climate are specifically considering *climate*, not *climate change*.

According to some workshop participants, such actions could be viewed as buying insurance. Other participants suggested that the insurance analogy was not an appropriate one, because it assumes that the probability of risks (i.e., real threats) is known and that all who might potentially be adversely affected buy insurance. These participants suggested that climate change was not an example of risk, but rather one of uncertainty, because the probabilities are not yet reliably quantifiable. Furthermore, the costs of many advocated policies are extremely high and, in contrast to most issues of risk, we can identify many of the sources of the problem (e.g., in this instance countries emitting greenhouse gases through processes of industrialization, forest clearing and food production).

A related issue is that of responsibility: who should bear the burden of financing actions to prevent, mitigate, or adapt to the regional impacts of global climate change? It was noted that responsibility has at least two important dimensions: one is related to causality and the other to moral obligation to assist those adversely affected by the impacts. With regard to responsibilities related to causes of climate change, participants suggested that precise responsibilities cannot be assigned according to quantitative criteria, because sources and sinks of greenhouse gases will vary over time and have not been accurately quantified (especially in relative terms over time), and because it is not clear who all the actors are. A critical issue in assigning responsibility is to identify the appropriate starting point, after which

those contributing radiatively-active trace gases to the atmosphere should bear responsibility for altering the global climate regime. In addition to these problems of attributing responsibility for climate change using quantifiable criteria, decisions about responsibility must also take into consideration qualitative criteria such as ethical and political factors. In particular, these concern differences between industrialized and developing countries in terms of relative standards of living and of rates of economic development. Hence, decisions, as they relate to obligation to correct causes or to compensate for regional effects of climate change, are even more tendentious. At present, there are no widely accepted methods by which to assign responsibility.

Technological developments undertaken in response to climate change represent a double-edged sword for developing countries. If, for example, developing countries choose to invest in new technologies designed to reduce the generation of greenhouse gases, they could be disadvantaged because of the economic and social costs associated with not pursuing other economic development options. This would be so, even if financial expenditures were to be covered to some degree by industrialized countries that seek ways to compensate for past and present emissions of greenhouse gases and that are concerned about the fate of future generations. Equally, if developing countries take these steps on their own and the scientific community's conclusions prove to have been erroneous, they may have unnecessarily closed off preferred development options. Thus, we must not assume that we will be correct in our assumptions about the relative benefits and costs of specific decisions, given the current absence of objective assessment methodology.

IV. EVENING SESSION: 19 JUNE

Following an approach of the IPCC, Michael Glantz presented lists of topics which, based on previous discussions and preparatory reading materials, were considered by the participants to be generally known, unknown, and undecided with regard to global climate change and its regional societal effects. Each point was discussed in open session by the participants. The following lists of 'knowns' and 'unknowns' have been revised in light of these and subsequent discussions, and represent a general consensus of the workshop participants. The list of undecided topics formed the basis for further discussion by the participants in a working group format (presented in the following sections).

What we consider to be known with regard to climate change and societal effects:

1. As with current climate, with a climate change there will be advantaged and disadvantaged countries, regions within countries, sectors, and populations.
2. The identity of those advantaged and disadvantaged will change over time; there are serious obstacles to their identification.
3. Specific changes in climatic parameters (e.g., more or less rain; higher temperatures) do not necessarily by themselves mean an automatic advantage or disadvantage.
4. Some countries, regions within countries, sectors, and populations are at greater risk in the sense of less capability for adaptation (either proactive or reactive adaptation). Developing countries are most at risk from the impacts of climate change.
5. Actions can be taken today to strengthen the ability of potentially vulnerable countries, regions within countries, sectors, and populations to cope with change.
6. Certain response strategies with regard to climate change would be beneficial to society, even in the absence of a climate change. Yet, even with such solutions, there are likely to be advantaged and disadvantaged.
7. Anthropogenically-induced climate change raises significant issues of international, intragenerational, and intergenerational justice.

8. The major contributors to changes in the chemical composition of the atmosphere are known.
9. Anthropogenic climate change will provide an opportunity to some countries, regions within countries, sectors, and populations to benefit economically and politically from such changes or responses to them.

What we consider to be unknown with regard to climate change and societal effects:

1. The magnitudes, distribution, and rates of changes in the climate system;
2. The degree of reversibility of changes in the climate system;
3. The relative distribution of advantages and disadvantages to any country, region within a country, sector, or population;
4. The indirect effects of climate change and of economic, social, political, and technological responses to those effects;
5. The implications of responses to climate change for economic development prospects of developed and developing countries;
6. The rates and abilities of adaptation by the environment and by society;
7. The degree to which specific climatic events or impacts are attributable to anthropogenic causes vs. natural processes;
8. How to determine the extent to which societal phenomena, such as population shifts, are attributable to climate change as contrasted with other natural and anthropogenic factors;
9. The impacts of climate change on unmanaged ecosystems within and beyond national jurisdictions and the weight these impacts should be given in assessments.

What we consider to be undecided with regard to climate change and its societal effects:

1. Whether to deal only with climate change or with climate change and climate variability, along with other underlying issues;
2. Whether responsibilities (however determined) should be explicitly identified;
3. How to deal objectively with the wins/losses issue;
4. How to relate climate-change-related inequities to existing present-day economic development disparities;

5. How to develop accurate perceptions of climate change and its impacts and transform them into political decisions;
6. How to determine the level of moral obligation of the present generation to future generations.

To provide a more detailed analysis of the 'undecided' topics, the participants were separated by their preferences into one of the three working groups to address the following areas of concern:

- A. Methodological considerations for assessing advantages and disadvantages in the context of a global climate change;
- B. The role of perceptions in attempts to identify and assess winners and losers (advantaged and disadvantaged); and
- C. Methodological and substantive issues related to the question of responsibility.

V. WORKING GROUPS: 20 JUNE

In the morning of 20 June, the three working groups met separately. At the plenary session in the afternoon, rapporteurs summarized the findings of their working groups. These presentations were followed by an open discussion in plenary session of the findings. The main findings of the working groups, incorporating suggestions from participants in the plenary session, are described in the following paragraphs. The complete reports of each working group, revised as a result of the discussions in plenary session, are in Appendix 4.

Working Group 1: Methodological considerations for assessing advantages and disadvantages in the context of a global climate change

Both objective and subjective criteria are used in attempts to identify relative advantages and disadvantages that might accompany climate change at the national and sub-national levels. Criteria for the comprehensive measurement of advantages and disadvantages include economic, social, political, ecological, and other indicators. They need to be applicable at different temporal and spatial scales as well as

at different levels of social organization. Quantitative assessments should incorporate not only traditional economic and social indicators, but should also consider distributive questions, such as those related to wealth and income distribution and the incidence of hunger. While objective criteria have the benefit of being easily measured in quantitative terms, they are often in the form of single values (e.g., means) whose range and distribution have not been explicitly identified. For instance, many such indicators are available only at a national scale such as GNP or GDP. As a result, significant differences between nations, subnational regions, sectors, and populations are often hidden. Moreover, objective measurement of non-market effects, such as changes in environmental quality, presents difficulties.

In relation to assessing advantages and disadvantages that might accompany climate change, quantitative and objective criteria must be used in conjunction with qualitative and subjective criteria. Both types of criteria, however, are susceptible to varying interpretations, because of many possible intervening factors such as differences among cultural and ethical systems and perceptual frameworks of the scientists who are undertaking these assessments. Thus, experts with different cultural and disciplinary backgrounds might use the same methodology but identify different advantaged and disadvantaged groups either at a particular point in time or over longer periods of time, because of the differences in the relative weights they might give to the individual indicators.

The aggregation of criteria represents another critical problem in assessing advantages and disadvantages over both time and space. Even at one point in time, some regions, economic sectors, or populations within a country could benefit from climate change, while others would be disadvantaged. The problem of aggregation becomes more troublesome, as assessments increase in temporal and spatial scale and consider higher-level political, social and economic effects of climate changes and responses to them.

In sum, the comparison and aggregation of these advantages and disadvantages is complicated by many factors, including the backgrounds of scientists undertaking assessments (as described in the previous paragraph), incomparability of criteria (e.g., economic criteria vs. social and ecological criteria which cannot be measured in economic terms), and the existence of different ethical and cultural systems even within one country.

The main conclusions of Working Group 1 were as follows:

- More research must be undertaken to develop objective methodologies for the assessment of winners and losers in the context of climate change, considering particularly difficulties in measurement and aggregation across varying space and time scales.
- To improve assessment methodology, detailed case studies should be undertaken to test and evaluate different methods. Priority should be given to conducting these studies in regions where climate is currently perceived as a limiting factor in socioeconomic development. In addition, criteria should be applied to case studies of the regional impacts of today's global climate regime in order to determine advantages and disadvantages. Once competing methods have been calibrated for their levels of objectivity and accuracy, they can be considered for assessment of gains and losses resulting from a global climate change.

Working Group 2: The role of perceptions in attempts to identify and assess winners and losers

The perceptions of scientists, the public, and policymakers are important to identifying and assessing realistically the winners and losers from the potential impacts of a global climate change. Both the public's and policymakers' perceptions may differ substantially from scientific assessments of the potential advantages and disadvantages of the possible impacts of climate change. Public perceptions are formed more through the media than directly from a reading of these scientific assessments, whose detail, significance, and ethical and value dimensions are often lost as a result of journalistic needs, e.g., the need for the condensation and

simplification of complex issues. Similarly, policymakers' perceptions are based on their own experiences and interests, as well as on their subjective evaluations of how their constituencies might be affected. As policymakers are often too busy dealing with many matters at one time and because they do not usually have sufficient scientific training to evaluate information about climate change objectively and independently, they must rely on the abilities of their staffs to translate this information into a format they can readily use. With only a few exceptions, they cannot by themselves directly use such information to make informed decisions. In some instances, scientific information may be used to justify decisions made for other reasons.

Direct experience affects the attitudes and perceptions of scientists, the public, and policymakers. Such experience, however, is not always useful in assessing benefits and costs of the consequences of climate change and responses to them because of the varying lead times before the realization of the different consequences of climate-related environmental changes. In addition, even longer lead times are associated with identifying the direct and indirect impacts of societal responses to these changes (i.e., actions taken or not taken). It is conceivable that some countries, regions, economic sectors, and populations who perceive benefits to themselves from specific policies in response to climate change will promote these. This may lead to alternative, equally appropriate but more broadly beneficial, strategies not being examined. Conversely, those who perceive potential losses to themselves or to their constituencies as a result of particular impacts or policy measures may not want to have these discussed. Obviously, many other possible scenarios such as these can be developed based on perceptions (realistic or not) of advantages or disadvantages that might accrue from global warming.

For these and other important reasons, researchers from all disciplines should intensify their efforts to develop appropriate methods to identify regions and sectors

likely to be affected by climate change, the magnitude and scale of such impacts, and the advantages and disadvantages of alternative policy responses. These assessments should be undertaken by multidisciplinary teams of scientists, and their findings must identify their degree of certainty (as well as degree of confidence), must reach the public in a comprehensible manner, and must lead to accurate perceptions of climate variability and change and possible policy responses. In particular, the media should treat climate change as a complex issue, which is not only of scientific interest, but also a matter of ethics, values, and justice. In fact, these responsibilities are shared by all those who contribute to the processes of communication and education on climate-related issues.

The main conclusions of Working Group 2 were as follows:

- There is a need for reliable and credible regional studies of the societal impacts of climate change and responses to it. Difficulties in undertaking such studies will be exacerbated by the different ways in which scientists of different backgrounds filter information and by the compounding of uncertainty along the chain of events from emissions of greenhouse gases to climate change to impacts on ecosystems and on societies. The last of these feeds back to changes in emissions.
- The perceptions of policymakers govern their decisions. These perceptions are based on their experience, interests, and evaluations of how their specific constituencies may be affected. In particular, it is often difficult to get political leadership on issues such as climate change, where important constituencies may be held accountable and, thus, forced to make significant sacrifices.
- In the search for appropriate responses to the impacts of climate change, those countries, regions, sectors, and populations that can present convincing rationales for actions from which they are likely to benefit are likely to be advantaged. This suggests that some possible response strategies may not be thoroughly examined in spite of their potential value.
- Those involved in communication and education must portray assessments of advantages and disadvantages deriving from climate change in ways that identify their degree of certainty, reach the

public, lead to accurate perceptions of climate variability and change, and consider how potential responses relate to issues of equity and values.

Working Group 3: Issues of responsibility

The atmosphere is part of the common heritage of humankind, and humankind as a whole has a responsibility to respond to climate change. The possibility of human-induced climate change in the next several decades raises important questions about justice, equity, causation, and responsibility. There are moral as well as legal issues of entitlement that concern the provision of resources (including information and technology for coping with climate change); the establishment of fair institutions for rule-making and dispute settlement; and compensation for harm. The methods available to address as well as assess such issues require attention.

The substantial inequities in economic and social conditions around the world are partly the result of historical political and economic relationships. Some of the inequities are the result of the same activities that raise the risk of climate change. As was noted in earlier workshop sessions, climate change may exacerbate existing inequalities in economic and social conditions within as well as between nations. Generally speaking, and other things being equal, those who are disadvantaged today are likely to become more disadvantaged during climate change because they have relatively fewer resources and capabilities to adapt to change and because they are less likely to control the decision-making process. This underscores the view that actions can and should be taken now to address existing inequities and to help those who are disadvantaged today. Policy responses to climate change should not increase such inequities.

In spite of difficulties in identifying precisely the relative total contributions of various countries or sectors to the causes of climate change, the 'polluter pays' principle, including both compensation for harm and historical causes, is a useful

starting point for evaluating relative responsibilities for climate change. Other factors to be considered in weighing responsibility include the ability of a country, sector or group to respond, as well as the need to improve the standard of living of the poorest people.

To minimize the adverse regional effects of climate change and determine how the burden of preventative action should be distributed requires: cooperative actions involving nations, inter-governmental institutions, and non-governmental organizations; the development of the international legal system; democratization of governmental institutions; and local participation in planning and implementation of policy responses to the regional impacts of global warming. These activities must seriously address the needs of both present generations and "subsequent" generations – a term that was chosen because it emphasizes the continuity of humankind. There are difficulties in determining the interests of subsequent generations and in arriving at fair and effective trade-offs between the interests of different generations. In addition, there is no agreed-upon mechanism for representing subsequent generations. Considerable work must be done on developing a framework and methods for determining fair and efficient trade-offs between the interests of present and subsequent generations.

The main conclusions of Working Group 3 were as follows:

- The possibility of anthropogenic climate change raises important issues of international and intra- and intergenerational justice.
- Certain actions can be taken now by all countries to assess and address existing inequities that would help disadvantaged countries, sub-national regions, economic sectors, and populations to respond to climate change.
- The 'polluter pays' principle, including compensation for harm, is a useful starting point for determining responsibility for anthropogenic climate change.

- To minimize the adverse effects on societies of climate change and determine how the burdens of preventive actions should be shared requires: cooperative actions involving nations, inter-governmental institutions, and non-governmental institutions; the evolution of the international legal system; democratization; local participation in the planning and implementation of policies; and improved assessment methodologies.

VI. FINAL SESSION: 21 JUNE

In the morning of 21 June, working group reports were made available to the participants. Each report was discussed in turn, first by working group members and then by all participants. The working group reports presented in Appendix 4 have been revised in light of these discussions to reflect the suggestions as well as consensus of the participants.

In this session a statement of issues of special concern to developing countries was compiled and presented by the participants from developing countries. The statement emphasized the need for the provision of resources to developing countries, noting particularly that financial, technical, and scientific assistance must contribute to self-determination and the long-term sustainable development of these countries. Such development, including economic, environmental, and social aspects, is the appropriate response for developing countries to cope successfully not only with climate change, but with climate variability as well. After discussion of their presentation in plenary session, the statement was revised to reflect the general support for the statement of all workshop participants. The revised version is reproduced in Appendix 5.

The main conclusion of this discussion was:

- Global concern about climate change should also be translated into global responsibility for the sustainable development of the developing countries through international financial, technical, and scientific cooperation.

WORKSHOP RECOMMENDATIONS:

In addition to other recommendations that appear throughout the report and the conclusions of the working groups, the following general recommendations are highlighted.

- There is a need for objective, reliable assessments of how nations, sectors, regions, populations might be advantaged or disadvantaged with climate change.
- There is a need for improved research on the perceptual aspects of the global warming issue, including the role of the media in forming climate change perceptions and the role of the perceptions of political leaders and how they affect the policy process on this issue.
- Attention should be focused on issues of climate change and intra- and intergenerational equity issues.
- Case studies should be undertaken at the regional level to develop methods for assessing gains and losses that might accompany a climate change.

APPENDICES

Agenda**ASSESSING WINNERS AND LOSERS
IN A GLOBAL WARMING CONTEXT**

18-21 June 1990

Hotel Dragonara Palace, St. Julians, Malta

17 June

7:00-9:00 p.m. Welcome "get together" at the hotel

18 June8:30-9:00 a.m. Welcome to meeting
M. Glantz (NCAR), conference organizer
A. Diamantidis (UNEP)
Deputy Prime Minister Guido de Marco, Malta9:00-10:00 a.m. Introduction to meeting
Participant introductions
Adopt/modify agenda

10:00-10:15 a.m. Break

10:30-11:00 a.m. Brief scientific overview of the global warming issue

11:00-12:15 p.m. What do we mean by change?
Is every change from the present necessarily a bad change?
Absolute change, relative change, rates of change
Changes in variability and extremes

12:15-1:30 p.m. Lunch

1:30-2:30 p.m. What constitutes a win in the climate change context?
What constitutes a loss?

2:30-2:45 p.m. Break

2:45-3:45 p.m. Are there examples of climate-related wins and losses in today's
global climate regime?

3:45-4:00 p.m. Break

4:00-4:30 p.m. Summary discussion

6:30-8:00 p.m. Open reception

19 June

- 9:00–10:30 a.m. How can wins and losses be measured?
Regionally, Nationally, Globally?
- 10:30–10:45 a.m. Break
- 10:45–11:45 a.m. Can wins and losses be aggregated?
- 11:45–1:00 p.m. Lunch
- 1:00–2:30 p.m. What is the relationship between perceptions of wins and losses
to the reality of wins and losses?
- 2:30–2:45 p.m. Break
- 2:45–4:30 p.m. Open
- 7:00 p.m. p.m. Group Dinner
- 8:30–10:00 p.m. Who wins if no action is taken AND the global climate regime
remains as it is today?
What might today's climate-related winners do to compensate
today's climate-related losers?

20 June

- 9:30–10:15 a.m. How does one deal with intergenerational equity issues?
- 10:15–10:30 a.m. Break
- 10:30–11:15 a.m. How does one deal with intragenerational equity?
- 11:15–11:45 a.m. Organization of working groups
- 11:45–1:00 p.m. Lunch
- 1:00–5:00 p.m. Preparation by working groups of their subgroup reports

21 June

- 9:00–11:00 a.m. Review of sub-group reports
- 11:00–12:15 p.m. Where do we go from here?
- 12:15 p.m. ADJOURN

APPENDIX 2

List of Participants

Workshop on

ASSESSING WINNERS AND LOSERS IN THE CONTEXT OF GLOBAL WARMING

Dragonara Palace Hotel, Malta, 18-21 June 1990

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Msida, Malta
- Dr. Ralph C. d'Arge**
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Global Issues Section
Ministry of Foreign Affairs
Valletta, Malta
- Mr. George Busuttil**
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Valletta, Malta
- Mr. A. Diamantidis**
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- Dr. Tibor Faragó**
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- Secretariat:**
Maria Krenz, Administrator
Martin Price, Rapporteur
Carmen Schlosser, UNEP/GEMS

APPENDIX 3

Short Biographical Sketches of Participants

David Attard is an international lawyer and professor in the Faculty of Law at the University of Malta. He first advised the Maltese Government to raise the issue of climate change at the United Nations General Assembly. He was for some time the special advisor to the UNEP Executive Director on the legal aspects of climate change. In 1987 Professor Attard was awarded the Guggenheim International Law Prize for his book *The Exclusive Economic Zone in International Law*.

Anthony Borg is Head of the Global Issues Section at the Ministry of Foreign Affairs of Malta. He is a graduate of the University of Malta and has attended the London Academy of Diplomacy. He has taught economics and served in the Ministry of Finance for ten years. He represents Malta at the IPCC and is vice-chairman of IPCC's Working Group III on Strategic Policy Responses to Climate change.

George Busuttil is Head of the Political Division at the Ministry of Foreign Affairs of Malta. He has served as First Secretary of the Malta High Commission in London, and has represented Malta during many international environmental negotiations. He was the Head of the Malta Delegation at the Vienna Convention and Montreal Protocol Meetings. He is presently involved in the IPCC process.

Ralph d'Arge is J. Bugas Distinguished Professor of Economics at the University of Wyoming, Laramie (USA). He holds a PhD in Economics from Cornell University. Dr. d'Arge is co-founder and managing editor of the *Journal of Environmental Economics & Management*. He was President of the Association of Environmental and Resource Economists in 1981 and received its highest honor, the distinguished service award in 1986. Dr. d'Arge has led numerous research studies on valuing attributes of the environment, including demand for water and air quality. He also served for six years on the Environmental Studies Board of the US National Research Council.

Guido de Marco is Deputy Prime Minister and Minister of Foreign Affairs and of Justice of Malta. Professor de Marco holds a Doctor of Law degree from the Royal University of Malta, where he taught criminal law. He was first elected as a member of the Nationalist Party to the House of Representatives in 1966, was Secretary General of the Nationalist Party, and has been Deputy Leader since 1977. He was a member of the Parliamentary Assembly of the Council of Europe for almost twenty years and represented the United Kingdom and the Mediterranean region on the Executive Committee of the Commonwealth Parliamentary Association. He has also represented Malta at a number of international conferences of Law Ministers. In September 1990 Professor de Marco was named President of the United Nations General Assembly.

Anastasios Diamantidis is an expert in International Affairs in the field of environmental policy, management and financing and has served with the United Nations Environment Programme since its inception in 1973, in Africa, Latin America and Europe. At present, he is Deputy Director of the Regional Office for Europe.

Denis Duclos is senior researcher in the National Center for Scientific Research (France) and co-director of the Center's research network, SORISTEC ("Society and scientific and technological risks"). This is a network of French social scientists interested in how society handles major chronic as well as accidental risks, including issues of global change. Dr. Duclos holds a PhD in Sociology and has studied how social actors deal with health, safety and environmental hazards generated by manufacturing. He has conducted surveys on risk perception and risk management and is the author of several articles and books.

Tibor Faragó is Head of climate research and applications at the Hungarian Meteorological Service. He holds a PhD in mathematical statistics and meteorological applications. His research includes theoretical and applied climatology, long-range weather/climate forecasts, and the interactions of climate and society. He is on the editorial board of the journal of the Hungarian Meteorological Service, *Időjárás (Weather)*, and of the Hungarian climate-impacts newsletter, *Atmoszféra*, and is the author of numerous scholarly articles in Hungarian, English, and Russian.

Michael Glantz is senior scientist with the US National Center for Atmospheric Research (NCAR) and the Director of the Environmental and Societal Impacts Group, a program of NCAR. He earned a PhD in political science (international relations) from the University of Pennsylvania. His research focuses on how climate affects society and how society affects climate, especially how the interaction between climate anomalies and human activities can affect quality of life. He is a member of numerous national and international committees and advisory bodies and is a recipient of UNEP's 'Global 500' award. He has edited several books and is the author of numerous articles on issues related to climate, environment, and policy.

Gary Hart is a former United States Senator from Colorado (1974-1987). As a member of the Senate's Environment Committee for 12 years, he was actively involved in all major environmental debates concerning air and water quality, toxic and hazardous waste disposal, alternative energy resources, and resource conservation. As a member of the Senate's Subcommittee on Nuclear Regulation, he chaired the Senate's special investigation into the Three Mile Island nuclear plant disaster. The report of this investigation led to substantial reforms in nuclear plant safety and licensing procedures. Senator Hart was the recipient of the "Legislator of the Year" award from the National Wildlife Federation.

Saleemul Huq is executive director of the Bangladesh Center for Advanced Studies, a private, non-profit scientific research institute working on environmental issues. He holds a doctoral degree in botany from Imperial College, London University, where he has also carried out post-doctoral research under a World Bank McNamara Fellowship. He has taught graduate and post-graduate courses and did research on plant physiology and biochemistry at Dhaka University, Bangladesh. Dr. Huq has established a program at the Center to determine how global climate change might affect Bangladesh and what the possible societal responses might be. He has published a number of papers in international journals and conference proceedings on this subject.

Helen Ingram is Director of the Udall Center for Studies in Public Policy at the University of Arizona (USA). She is a professor with a joint appointment in the Department of Political Science and the School of Public Administration and Policy. Dr. Ingram is book review editor of the *American Political Science Review* and a member of the Council of the American Political Science Association. Her research interests are in the areas of public policy and American politics, particularly policy design and implementation. She has written extensively on regional water issues.

Dale Jamieson is Director of the Center for Values and Social Policy and Associate Professor of Philosophy at the University of Colorado-Boulder (USA). He is also an adjunct scientist with the Environmental and Societal Impacts Group at NCAR. He has worked on various topics in ethics, political philosophy, and environmental philosophy. He has written about various social aspects of global environmental problems, including difficulties in forecasting the future, policy problems about biodiversity loss, inadequacies of purely economic approaches to environmental problems, and the new values that are needed to cope with life in an interconnected, highly technological world.

Wangari Maathai is the founder and coordinator of the Green Belt Movement in Kenya, which is a grassroot environmental movement with tree planting as its focal activity. She has an MS degree from the University of Pittsburgh and a PhD degree in botany from the University of Nairobi, where she taught for several years. Dr. Maathai has published papers in scientific journals as well as two books on the Green Belt Movement.

Antonio Magalhães has recently retired as Deputy Superintendent of the Institute for Socioeconomic Planning and State Secretary for Planning in the State of Ceará, Brazil. He holds a PhD in economics from the University of São Paulo, Brazil. His career has been devoted to the promotion of socioeconomic development as a development planning expert in the Federal and Ceará State governments. His present areas of interest include climate impact assessment in Brazil, and the development of methodologies for the sustainable (economic, social, environmental) development planning process. He has represented the Brazilian Government in the IPCC Working Group III on Strategic Policy Responses to Climate Change.

Daniel Magraw teaches Public International Law, International Environmental Law, International Business Transactions, and International Development Policy and the Law at the University of Colorado School of Law. He has a Juris Doctor degree from the University of California, Berkeley and has worked as an economist and business consultant in India with the Peace Corps and has practiced international law and constitutional law in Washington, DC. Among other professional activities, he is Chairman of the International Environmental Law Committee of the ABA's Section of International Law and Practice. He has written articles and books on many international law subjects; his most recent projects include a book on international law and pollution, and a coursebook on international environmental law.

Klaus Meyer-Abich is professor of Philosophy at the Institute for Cultural Studies in the Science Center of North Rhine Westfalia and at the University of Essen. He studied physics, philosophy and history of science at Hamburg, Göttingen, Bloomington, Indiana and Berkeley, California. He holds a PhD in Philosophy. He has served as a member of the Enquête Commission on Future Energy Policy of the German Parliament and as Minister for Science and Research of the Federal State of Hamburg. He is presently a member of the Enquête Commission on the Protection of the Atmosphere of the German Parliament. He has written numerous articles on issues related to philosophy and science, ecology and social responsibility, among other topics.

Philippe Roqueplo is a Director of Research at the National Center for Scientific Research of France. He holds a PhD in Theology and is co-director of the Center's research network, SORISTEC ("Society and scientific and technological risks"). His research has been in the area of conditions of social control of technological development and has several books and numerous articles published in this field. Dr. Roqueplo has studied the socio-political aspects of acid rain and has advised the French Ministry for the Environment on energy issues. He is presently looking at the sociocultural credibility of scientific expertise in the area of global warming.

Naresh Singh is Executive Director of the Caribbean Environmental Health Institute, which serves 16 English-speaking Caribbean countries in a wide range of environmental activities. He holds a PhD in Environmental Chemistry from the University of West Indies (Jamaica) and has served as Senior Scientist responsible for Coastal and Marine Program of the Scientific Research Council of Jamaica. He is a member of the Technical Advisory Committee of the Caribbean Conservation Association, the IOC/IOCARIBE Group of Experts on Marine Pollution in the Caribbean and of the UNEP Task Team of Experts on Potential Climate change and its Impacts in the Caribbean. He is the author of over 30 publications on a wide range of environmental issues.

David Streets is Director of the Policy and Economic Analysis Group of the Environmental and Information Sciences Division at Argonne National Laboratory (USA). He received a PhD in physics from the University of London, England, and has been a Postdoctoral Fellow under the National Science Foundation and the Imperial Chemical Industries. He is presently responsible for management of an interdisciplinary group of 60 researchers analyzing energy, environmental, and economic issues. Dr. Street's scientific investigations during recent years have involved the design of cost-effective policies for reducing emissions that cause acid rain and global climate change. He has published 50 scientific papers and over 100 technical reports.

Igor Zonn is Head of the Foreign Relations Department of the "Soyuzvod-proekt." He holds a PhD in geography and has worked on various topics related to the development of arid and semiarid lands, and problems of desertification. He was the first project coordinator of the UNEP/USSR project "Combatting desertification through integrated development." His present areas of interest include links between climate and desertification and the use of traditional and nontraditional technologies for the sustainable development of arid lands. He is the author of over 150 articles and books.

APPENDIX 4
Working Group Reports

Working Group 1: Methodological considerations for assessing advantages and disadvantages in the context of a global climate change

1. Questions Addressed:
 - 1.1 What do we mean by winners and losers in potential climate change? What are some of the criteria (objective and subjective) and levels of analysis that could be used to identify possible winners and losers?
 - 1.2 What methods could be used to assess potential winners and losers?
2. Outcome: The outcome described below is an initial attempt and does not provide specific answers to the questions above. These full answers are not available at this time. This outcome derives from the group's discussions, as modified by comments from the plenary session, and can be summarized as follows:
 - 2.1 Objectively Verifiable Indicators:
 - 2.1.1 Economic: GDP per capita, disposable income per capita, employment rate, wealth per capita, savings per capita, etc.
 - 2.1.2 Social: Life expectancy, infant mortality, thresholds of poverty, incidence of hunger, average level of educational achievement, etc.
 - 2.1.3 Socio-economic: It was noted that integrated socio-economic functions such as productivity might be more meaningful.
 - 2.2 Subjective (or more difficult to measure) criteria:
 - 2.2.1 Flexibility in structure of economic output: Greater flexibility would favor winners and vice versa.
 - 2.2.2 Resilience of ecosystems: Greater resilience, which could be the result of greater adaptability would favor winners and vice versa.
 - 2.3 Applicability of Criteria: It was agreed that the criteria need to be applicable and indeed to be applied to different temporal and spatial scales as well as at different levels of the social structure. The levels could include grouping of countries, nation states or regions within a country. All of this implies that we can identify winners and losers, but there are constraints on the analytical

process or framework. Given the method(s), criteria and scales, there could be different sets of winners/losers over time, etc.

2.4 Methods: Assessment methods would include both quantitative and qualitative methods.

2.4.1 Quantitative methods. These would include, inter alia:

- social, economic, and financial cost-benefit analyses
- systems analysis
- integrated simulation models (including shadow pricing, etc.)
- econometric models
- cost-effectiveness analysis
- macro-economic analyses (Keynesian)
- environmental assessments
- detailed case studies of the interfaces among climate, ecology, and economy, especially in regions where there are some ecological constraints to development and social equilibrium

2.4.2 Qualitative methods:

- development of regional scenarios
- environmental assessments
- risk analysis and assessment

2.4.3 Limitations:

- The lack of comparable ethical systems among and within countries will prevent consistent and acceptable application of the methods and criteria and consequently prevent consistent and acceptable assessment of gains and losses or winners and losers.
- The final perceptions of themselves based on their value systems will determine whether groups see themselves as winners or losers.

2.5 Examples of potential winners and losers:

- In those economies (of either nations or regions within nations) where climate is the limiting factor to development, climate change will lead to distinct advantage or disadvantage (e.g., Wyoming, Ethiopia, Aral Sea).
- Winners would include individual companies, industries or countries that could sell services or technologies needed for remedy or mitigation of adverse impacts due to climate change.
- Developing countries are likely to be losers in general, because of their lack of response capability and options.

2.6 Recommendations

1. Detailed case studies to test the methods and criteria as applied to today's climate scenarios vis-a-vis advantaged and disadvantaged groups should be conducted urgently. Potential future climate scenarios can then be considered.
2. Strategical data about the political implications of the balance between possible economic gains and the socio-economic consequences of climate change need to be compiled.
3. The severity and consequences of the losses of the potentially greatest losers need to be estimated and mitigation measures agreed upon and implemented.

Working Group 2: The role of perceptions in attempts to identify and assess winners and losers

Perceptions govern policy making. Policymakers' perceptions are based on their own experience, interests, and evaluations of how important constituencies are affected. Consequently, decision-makers' perceptions may differ substantially from scientific assessments of the advantages and disadvantages of the impacts of climate change.

The perceptions that govern decision-making are subject to considerable distortion by political interests that have stakes in particular construction of issues and/or solutions. In many policy areas, direct experience corrects errors in perceptions. In contrast, the long lead time required before evidence confirms or fails to confirm perceptions of the costs and benefits of climate change prevents direct experience from being useful. It is, therefore, particularly important for the scientific community to provide information to correct distortions in perceptions.

1. Conclusions

- (a) There is less information about the impacts of climate change than about possible changes in the climate system, for two reasons. First, more climatological than impacts studies have been done. Second, it is more difficult to study impacts, which are especially filtered through perceptions. This perception problem is further exacerbated by the compounding of uncertainty along the chain of events from emissions through climate change to climate impacts.

- (b) The scale of potential wins and losses is important. Few can be assessed at a national level. For most others, there are significant problems of aggregation across sectors within countries. Perceptions are region- and sector-specific. The more that wins and losses are aggregated, the more likely perceptions will be inaccurate.
- (c) In the competition to find solutions to the impacts of climate change, those countries, regions, sectors, and populations that are prepared to portray their preferred strategy as reasonable and responsive are likely to be advantaged. This also means that some strategies may not be examined in spite of their potential value.
- (d) Some potential losers may have enough information to allow them to perceive that they are losers, although they may not know the timing or magnitude of losses.
- (e) Some potential winners and losers may not want information about the impacts of climate change to be disseminated, unless they perceive that potential net advantages would result. This is because such dissemination might influence their economic development, cause a decline in morale, affect their political future, etc.
- (f) Public perceptions are formed more through the media than through scientific information. The full impact of scientific knowledge and uncertainties is often lost as the media attempt to simplify and to sustain readers' interests through the portrayal of controversies and the identification of villains. The significance of the ethical and value dimensions of policies chosen to deal with climate is often lost as it is communicated through the media as a science and technology matter. Time and deliberation will be required to clarify and consolidate more accurate perceptions in this area.
- (g) When the complexity of scientific information is reduced, important details tend to be lost, and distortions may appear. In the search for simplicity in statements about climate change, some causes may be blamed while others are not identified. Similarly, not all possible responses may be explored.
- (h) Policy making requires scientific information. Yet few policymakers have a sufficient scientific background to objectively and independently evaluate information about climate change provided by scientists and filtered through the media and their staffs. Yet, until a policy-maker understands the impact of scientific information, he or she cannot make an informed decision. Policymakers may instead use scientific information to justify decisions that are made on other grounds.

- (i) It is difficult to get leadership on issues where important constituencies may be held accountable and thus forced to make significant sacrifices; both of these elements apply to the issues of climate change.

2. Recommendations

- (a) The scientific community should intensify its efforts to identify regions and sectors likely to be affected by climate change and the magnitude and scale of these impacts. This should be done before the focus of assessment moves to evaluating the consequences of potential responses to climate change.
- (b) Many more impact studies, at scales from the sub-national to the global, are required. These studies must be undertaken by interdisciplinary teams of scientists from both social and natural sciences, involving as many indigenous scientists as possible. These studies should be internationally funded and undertaken so that they are respected within the scientific community at large.
- (c) Information from these studies must include statements as to the degree of certainty and must be disseminated both internationally and locally, using terms understandable to policymakers, the media, and the public.
- (d) Scientific information must be communicated in ways that will reach the public, stimulate accurate perceptions of climate variability and change, and correct imbalances in the availability of information. This responsibility is shared by all those who contribute to the processes of communication and education: scientists from the various disciplines relevant to climate, science writers, and writers for popular journals and the mass media.
- (e) The media should treat the issue of climate change with care and sensitivity. The complexity of the issue needs to be acknowledged, and it should be treated not just as a scientific issue, but also as a matter of ethics, values, and justice. Treating the issue in this way will help to avoid unnecessarily alarming or reassuring the public.

Working Group 3: Issues of responsibility

The atmosphere is part of the common heritage of humankind. Thus, humankind as a whole has a responsibility to respond to climate change. Although climate change will produce advantaged and disadvantaged countries, regions within countries, sectors, and populations, it is still the common concern of humankind.

1. Justice

The possibility of anthropogenic climate change raises important issues of international justice. There are moral as well as legal issues of entitlement that concern the provision of resources (including information and technology for coping with climate change); the establishment of fair institutions for rule-making and dispute settlement; and compensation for harm.

2. Intragenerational equity

a) There are substantial inequities in economic and social conditions around the world. These inequities are partly the result of historical political and economic relationships.

b) Some of these inequities are the result of the same activities that raise the risk of climate change.

c) Those disadvantaged under existing circumstances are likely to become more disadvantaged during climate change because they have fewer resources and capabilities to adapt and because they are less likely to be in control of the decision-making process.

d) Certain actions can be taken now by all countries to address existing inequities that would help disadvantaged countries, regions, sectors, and populations to respond to climate change.

3. Causation and responsibility

It is important to identify contributions to the build-up of greenhouse gases because the 'polluter pays' principle, including compensation for harm, is a starting point for determining responsibility, even though there are difficulties in applying this principle to climate change. One of these difficulties is that we do not fully understand all the anthropogenic forcings that determine climate change. Moreover, there are other bases, in addition to the 'polluter pays' principle, for determining responsibility. These include the ability to respond, and the need to improve the standard of living of the poorest people.

There is a responsibility to ensure that policy responses to climate change do not result in further economic and social inequalities.

International cooperative action, involving nations, inter-governmental institutions, and non-governmental organizations, is needed to minimize the adverse effects of climate change. Similar international cooperation is needed to determine how the burden of preventative actions should be shared, addressing how and where

the most effective proactive actions can be taken and who is most able to bear the associated costs. Such actions should include special assistance, such as financial and technical assistance, to developing countries in order to reduce forcing activities and create or strengthen capabilities to respond to climate change.

Democratization of governmental institutions and organizations and local participation are needed in responding to climate change.

4. Intergenerational equity

In responding to anthropogenic climate change, it is necessary to consider the impacts on subsequent generations of humankind. There may be trade-offs between the interests of present and subsequent generations with respect to climate change. There are difficulties in determining the interests of subsequent generations and in arriving at fair and efficient trade-offs between the interests of present and subsequent generations. There is no agreed-upon mechanism for representing the interests of subsequent generations. Much work must be done in these areas.

5. International legal issues

The international legal system and international law should be developed to contribute to the resolution of the questions of intra- and inter-generational equity, causation, and responsibility.

APPENDIX 5

Issues of Special Concern to Developing Countries

The participants in the workshop "On Assessing Winners and Losers in the Context of Global Warming," held in Malta from 18 to 21 June 1990, declare:

- (1) Since the atmosphere belongs to the common heritage of humankind, the issue of climate change and its impacts constitutes a concern of both developed and developing countries.
- (2) The causes of a possible anthropogenic climate change, in terms of both stock and fluxes of greenhouse gas emissions to the atmosphere have originated mainly from economic activities in the developed world; however, the response strategies to climate changes shall be taken by both developed and developing countries.
- (3) Though there will be winners in both developed and developing countries, there will tend to be more losers than winners among the developing countries, because of their lesser adaptation capability.
- (4) Developing countries will also be losers in relation to the strategic responses to limit climate change, because these necessary strategies will impose restrictions on development goals and will require technology transformation and investments that are not available to most developing countries.
- (5) Global concern about climate change should also be translated into global responsibility for the sustainable development of the developing countries through international financial, technical, and scientific cooperation.
- (6) The need for international financial, technical, and scientific cooperation will have important economic and political consequences for both developing and developed countries. The latter will have to organize cooperation in order to share the burdens and distribute possible profits in relation to these burdens and their own responsibility for global warming.
- (7) In many cases, particularly for developing countries, there is much that can be done today to increase their capabilities to cope with the negative impacts of climate change and associated natural hazards and benefit from potential opportunities. Such actions should be taken now.
- (8) The democratization process now sweeping many parts of the world is a necessary prerequisite for sustainable development and community participation in activities which will alleviate climate change, especially in developing countries.

- (9) Financial assistance to developing countries, as it is given today, can be a disempowering process which exacerbates poverty and underdevelopment, which is likely to promote activities that will make adaptation to climate change much more difficult. This type of aid encourages corruption both at local and international levels and is a major contribution to continued impoverishment of the poor people of developing countries. The best kind of aid would contribute to self-determination and the long-term economic development of these countries in an environmentally sound manner.
- (10) There is an understanding that the achievement of sustainable development (including economic, social, and environmental factors) is the appropriate response for developing countries to cope successfully with climate change. Hence, sustainable development has to be promoted.
- (11) There is a need to promote general and environmental education as a condition for sustainable development, and for generating and disseminating climate-related information, in order to improve understanding of impacts and possible responses.