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State of the Art and Future Challenges for Integrated Environmental Assessment

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ABSTRACT

A concise review of the evolution of the integrated environmental assessment field is presented. The opening conference of the European Forum on Integrated Environmental Assessment in 1998 is taken as a reference point. A mixed record of notable accomplishments and modest progress is detected in surveying examples in four large areas of concern to the integrated assessment community: modeling, participatory techniques, mega-assessments involving hundreds of people for several years, and organizational and community issues. Plausible reasons for slow progress in participatory assessments are sketched and possible remedies are suggested. Examples of the challenges facing the integrated assessment community are elaborated in three areas: the identification of integrated assessment as a discipline and/or profession by clearly defined distinctive features, thematic issues to be resolved, and methodological improvements that are possible and needed.

Keywords: integrated environmental assessment, modeling, participatory methods, climate change.

1. INTRODUCTION

Over the past two decades, the term integrated environmental assessment (IEA) has evolved into an umbrella concept for multidisciplinary analysis of environmental problems with the explicit objective to support policymaking. IEA activities typically draw on a range of scientific disciplines that provide a large array of complex information of different kinds and degrees of uncertainty. The special challenge is to accommodate the wide variety of perspectives and to represent the diverging and often contradicting interests of the affected stakeholders. Many tools have been developed to tally and consolidate the relevant information, to package them in different analytical frameworks, and to present the results to those responsible for making the decisions. The first phase of the European Forum on Integrated Environmental Assessment (EFIEA-I) was launched in 1997 to provide an opportunity for the growing community of IEA practitioners to share their expertise, to compare their experiences, and to improve the profession of IEA. The contribution by Vellinga [1] presents a comprehensive review of the achievements and products of EFIEA-I.

The task of this paper is to highlight some of the most important developments in IEA over the past few years and to draw attention to a few topics and unresolved issues that might be usefully addressed by the integrated assessment community. In a fast developing field like IEA, it would be virtually impossible to prepare a comprehensive overview. Similarly, given the wide range of unresolved environmental policy issues, it is impossible to give an all-inclusive list of possible application areas. Accordingly, both the appraisal of the past and the survey of the future are selective and incomplete.

The paper starts out by looking back at the core contributions to the initial stocktaking effort by the EFIEA-I at its 1998 opening conference. Section 3 presents examples of the main achievements in the field of IEA by looking at four areas: modeling, participatory assessments, a mega-assessment conducted by the Intergovernmental Panel on Climate Change (IPCC), and finally organization and community issues. Triggered by the considerable difference between the impressive progress in modeling and the relatively modest achievements in the field of participatory assessments, Section 4 discusses some reasons why the progress in participatory techniques has been slow. The new challenges and opportunities for IEA are highlighted in Section 5. The paper is concluded by summarizing the main points.

2. EFIEA-I: INITIAL STOCKTAKING IN 1998

The first phase of EFIEA started with an inspiring conference entitled "Challenges and Opportunities for

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IEA" in March 1998. The invited keynote papers were published later that year as a special issue of Environmental Modeling and Assessment [2]. This event and its products constitute a useful reference point in appraising successes and failures over the past four years.

Tol and Vellinga [3] present a broad overview of the activities serving as a starting point for EFIEA-I. They review a number of IEA definitions and propose a catholic version encompassing the general scheme of integrated assessment (IA): structuring the problem, analysis by modeling or participation, and communication of the results. They specify the main tasks for EFIEA-I in two categories. The methodology program should devote special attention to the following challenges: the treatment of uncertainty in IAs, rigorous model analysis and comparison, the problems arising from the need to combine processes at different spatial and temporal scales, the understanding and representation of structural change, and the ways and means of combining qualitative and quantitative analysis. They specify three topics for the policy program: climate change, water, and transport.

Rotmans [4] also lists a number of challenges and opportunities for IA in general and for the community gathered in EFIEA in particular. His concept of IEA emphasizes the double objective to provide (i) adequate characterization of complex interactions and feedbacks, and (ii) support for public decision making. Rotmans also specifies two groups of methods: analytical (embracing models, scenarios, and risk analysis) and participatory (including dialogue methods, policy exercises, and mutual learning methods). His list of the general methodological challenges also includes the problems of aggregation versus disaggregation, the treatment of uncertainty, and the blending of qualitative and quantitative knowledge.

The proposition by Rotmans [4] is that IAMs need to build up scientific and political credibility and address a series of thematic issues like demographic transition, environmentally related human behavior, technological innovation and diffusion, and urbanization and migration. The main tasks for practitioners working with participatory methods are to develop these methods, to improve the quality of the assessment procedures, to develop protocols for aggregation/disaggregation, to link spatial and temporal scales, and to foster dissemination of results.

Rotmans specifies a remarkable list of recommendations for IA practitioners and for the European Forum. The list includes the need for:

– codes of practice: a European task force to formulate a check list
– synthesizing the analytical and participatory sides of IA: initiate demand-driven and supply-driven pilot projects
– practical examples of IA: initiate regional case studies
– improving IA tools and methods: improve transparency, next generation of IA tools to incorporate "new scientific streams" (complex systems, adaptive behavior, bifurcations)
– entering new problem areas: water, technological development, health care, transport, infrastructure

As the survey by Vellinga [1] of the activities and achievements of EFIEA-I indicates, some of these tasks have been fulfilled by the Forum (like the outreach to the water and transport communities), other tasks have been taken up by practitioners in the IA community (regional integrated assessments to address region-specific environmental problems, improvements of the IA methods and tools), while some items on the list turned out to be less interesting or impractical to follow. For example, a list summarizing the experience of IEA practitioners about formulating and designing an IA project, about the advantages and pitfalls of using different methods in different problem areas under different circumstances might be useful, especially for newcomers. However, a rigid "code of practice" would be counterproductive and would likely be ignored in a field that is considered to be a blend of art and science by many. Scientific rigor stems partly from the disciplines from which concepts, results, or complete analytical modules are incorporated, and partly from the paradigms underlying the integration methods and frameworks. At this point it is difficult to see whether it would be possible (and if it was, it would be beneficial) to pin down specific "rules of conduct" for a field as diverse as IEA.

In another contribution to the initial stocktaking conference, Toth and Hizsnyik [5] present a concise overview of the evolution and applications of IEA methods. They regard IEA as the culmination of a multi-decade evolution in environmental sciences and policy. They conclude that changes in the nature, the social perceptions, and the management of environmental problems drive the developments in the assessment concepts and methods to address them, and technologies (satellite imagery, GIS, increasing computer power, information sharing via the Internet) pave the way for their increasingly effective applications.

Based on the results from a large international project concerned with the social learning in the management of environmental risks [6], Toth and Hizsnyik [5] adopt the structure of the complex process of environmental management according to risk management functions and take a closer look at the role of IEAs in relation to those functions. The functions include monitoring, risk assessment, response assessment, goal and strategy formulation, implementation, and evaluation. The authors conclude that the need and the specific requirements for IAs vary across the risk management functions therefore no single, all-encompassing IA is suitable to serve the policy process. Different assessments are needed in different phases of the environmental management process and they are best served by different methods.

The observation by Toth and Hizsnyik [5] about the methods for environmental assessment is that demand tends to drive the development of new assessment frameworks and techniques. Methods that successfully serve the information needs of potential users are accepted and become widely used such as the Adaptive Environmental Assessment and Management method (AEAM) since the late 1970s. In contrast, efforts to artificially create demand for ''visionary'' creations in IEA remain questionable.

Two essays discuss the multifaceted relationships between environmental science and policy. Jäger [7] examines the use of scientific findings in environmental policy making. Based on a large number of practical examples, she concludes that no linear/sequential linkage exists between the science and policy domains. The IEA community needs to be aware of the intricacies of this relationship in order to become more useful in the policy formulation process. This important point is confirmed by Haigh [8] in the second essay. He maintains that if IEA is to influence environmental policy, its practitioners need to achieve a profound understanding of the policy-making process and frame their assessments accordingly. This is a special challenge in the European Union due to the large diversity of traditions, laws, and procedures across its nations and regions.

3. MAIN ACHIEVEMENTS AND FAILURES

This section presents a few examples of interesting developments in the field of IEA over the past few years. We start with integrated assessment models (IAMs), by far the most dynamic domain. This is followed by a short review of the rather reticent activities in developing and using participatory techniques. Next, we reflect on a mega-assessment completed during EIFEA-I, the Third Assessment Report by IPCC. Finally, important achievements in organizing the IEA community are reported briefly.

3.1. Integrated Assessment Modeling

Climate change has been the most heavily frequented environmental problem studied by what are explicitly called integrated assessment models (IAMs). By the late 1990s, IAMs have become widely recognized as the most appropriate tools to generate policy-relevant insights into the climate change problem. The policy debate in preparation for the Third Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) and after the signing of the Kyoto Protocol raised a large number of questions on which policy makers requested clarification. Most IAMs developed in the early 1990s were extended in response to this demand by adding new equations or completely new modules. Results from inspired IAM extensions and inventive applications are reported in a large array of scientific journals after rigorous peer review. Nevertheless, a word of caution is appropriate here: modelers should not extend their tools far beyond their original objectives because this might jeopardize the internal consistency and the integrity of the IAM. The other pitfall modelers should avoid is trying to capture everything in single framework and ending up with a far too general and therefore useless model. In addition to the extensions of existing models, the late 1990s also saw the development of new analytical frameworks and IAMs operationalizing them as well as the conception of new approaches to integration.

One of the best examples of imaginative and informative IAM extensions is the Climate Framework for Uncertainty, Negotiations, and Distribution (FUND) model by Tol [9–11]. The model has been revised and extended to incorporate better assessments of climate change impacts and the associated economic damages and to analyze the role of technological development in the timing of emissions reductions efforts. Further extensions of the model provide interesting results about the nature and consequences of changes in large earth-systems processes (such as the possible collapse of the thermohaline circulation) and about the associated mitigation strategies. Yet another set of extensions and model runs investigates the implications for intergenerational equity of adopting different fairness principles, discounting concepts, and discount rates. These model extensions contribute both to the scientific understanding and to the management of the climate change problem. Even this incomplete list of extensions and applications of the FUND model demonstrates the flexibility of the tool (the integrated assessment model) and the creativity of the modeler.

Let us take one example to show the kinds of insights one can gain from such an integrated assessment model. The example concerns the implications of climate change for climate-related diseases, in this particular case malaria. Tol [12] observes that malaria is the disease of the poor: data published by the World Health Organization show that people with an annual income of USD 3,000 or more do not die of malaria. In all scenarios of long-term socioeconomic development, which are widely used in the climate change studies, incomes in all regions of the world will be growing therefore people will become less vulnerable to malaria irrespective of whether it is caused by climate change or not. Tol observes that, according to the IPCC IS92A scenario, all regions pass the USD 3,000 income threshold by 2085. If part of the income is diverted to climate protection in preceding decades of the 21st century, this income threshold would be surpassed somewhat later.

The complex relationships among anthropogenic climate change, its effect on malaria-mortality, emissions reduction, and its implication for economic growth are presented in Figure 1 based on Tol and Dowlatabadi [13] and Tol [12]. Progressively more ambitious emissions reductions in OECD countries gradually decrease the cumulative malaria-mortality if we consider only the impact side, i.e., the biophysical effects of climate change mitigation on malaria prevalence. However, if we also take into account the

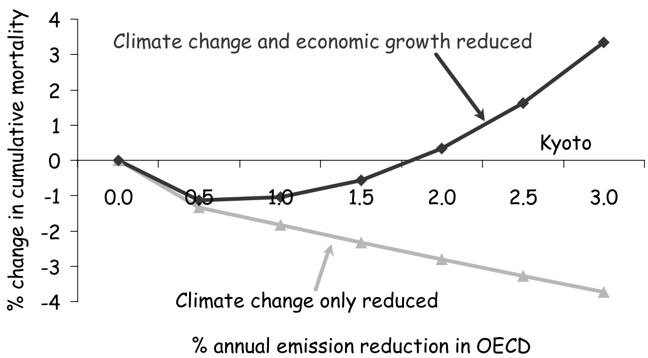

Fig. 1. Relationships among climate change, malaria-related mortality, and climate change mitigation costs. Source: Tol [12].

economic effects of mitigation efforts (the slower rate of economic growth) then, according to the FUND model, the malaria-mortality improvements due to slower global warming will be gradually eliminated and eventually surpassed by the losses due to the reduced rate of income growth. This example demonstrates that overzealous climate change mitigation will not necessarily result in reduced mortality from climate-related diseases. Tol [12] extends this analysis to assess the feedback of health on economic growth.

The unique combination of the characteristics of the climate change problem (long-term, global, multiple causes and diverse implications, large uncertainties, the potential of irreversible changes, etc.) makes the applications of traditional decision-analytical frameworks difficult. This calls for developing new analytical frameworks that are better suited to characterize and analyze the special features of climate change. This is all the more desirable because, as Yohe [14] argues, the relative strengths and weaknesses of different analytical frameworks ensure that their combined contributions provide the really valuable policy insights.

Toth [15] and Toth et al. [16, 17] present a recently developed framework called the tolerable windows approach (TWA). Its main focus is on the long-term dynamics of the interactions between mankind and the climate system. The TWA seeks to identify fields of long-term greenhouse gas emission paths that prevent rates and magnitudes of climate change generating what is considered to be unacceptable regional or sectoral impacts without imposing intolerable mitigation costs on societies. This approach detaches the normative judgments concerned with the limits to unacceptable impacts and costs from the scientific analysis of the, albeit uncertain, relationships among emissions, radiative forcing, climate change, and impacts. Based on the socially determined decisions of what constitutes (un)acceptable impacts and mitigation costs, the TWA-based integrated assessment model produces corridors of long-term emission paths. While not any arbitrary emission path within the corridor is necessarily a permitted path, any path leaving the corridor would clearly hurt the user-specified climate and/or cost constraints.

An example of the kinds of results one can obtain by using the tolerable windows approach is presented in Figure 2 based on Bruckner et al. [18]. This simple example is based on the following specifications:

(i) Climatic constraints: the change in global mean temperature relative to the pre-industrial level should not exceed 2 °C and the rate of temperature change should not be above 0.2 °C per decade over the time horizon up to 2200;
(ii) Socioeconomic constraints: the maximum acceptable climate protection cost is associated with the rate of change in energy-related CO_2 emissions and this rate should not exceed $\pm 3\%$/year;
(iii) Additional specifications: land-use-related CO_2 emissions and non-CO_2 greenhouse gas emissions are prescribed in line with the average of the four IPCC SRES (2000) marker scenarios until 2100 and kept constant thereafter;
(iv) Furthermore, SO_2 emissions are linked to CO_2 emissions with a 1%/year autonomous desulfurization rate.

It is important to indicate that the first two points above are examples of the kind of normative constraints that can be specified for an inverse analysis by social actors as users of the model. These specifications should by no means be interpreted as science-based recommendations of the modelers. The last two points simply characterize the scenario assumptions as the context of our analysis.

The emission corridor shown in Figure 2 contains all energy-related CO_2 emission paths that satisfy the

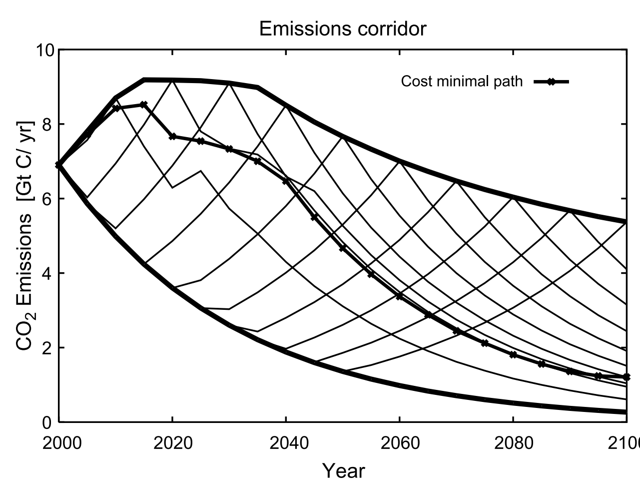

Fig. 2. Demo result obtained with the ICLIPS integrated assessment model. Depicted are the upper and lower boundaries of the emissions corridor that delineate the set of all admissible paths of energy-related CO_2 emissions. The thin paths are used to derive the boundaries of the emissions corridor. Source: Bruckner et al. [18].

constraints specified in (i) and (ii) under the model specifications according to (iii) and (iv). The corridor is the permitted field for long-term carbon emissions in the sense that, while not any arbitrary path within the corridor is necessarily a permitted path, any path leaving the corridor certainly violates at least one of the specified constraints. The tolerable windows approach is useful in delineating the maneuvering room for long-term carbon emissions and can be the starting point in the search for specific emission paths within the corridor based on additional policy specifications. The ICLIPS framework also includes climate impact response functions [19, 20] that represent the response of climate-sensitive sectors to incremental climate and carbon concentrations forcing and are intended to help policy makers to make informed choices regarding the acceptable climate change impacts in their regions and/or sectors.

Another important new development in EIA in the past few years is an innovative integration of scenarios, modeling, and participation. The issue to address is sustainability, an intriguing and highly controversial concept. The multi-faceted nature (environmental, social, and economic) of the sustainability concept require new modeling concepts and techniques. Rotmans et al. [21] develop new approaches and tools in the VISIONS project. Their objective is to produce a range of visions for sustainable development in Europe. The themes addressed by the project include equity, employment, consumption, and natural resources. The project undertakes analysis in a range of sectors like water, energy, transportation, and infrastructure. Finally, the project also involves a range of stakeholders from government, business, NGOs and the scientific community. Figure 3 presents the integrated assessment framework used in the VISIONS project.

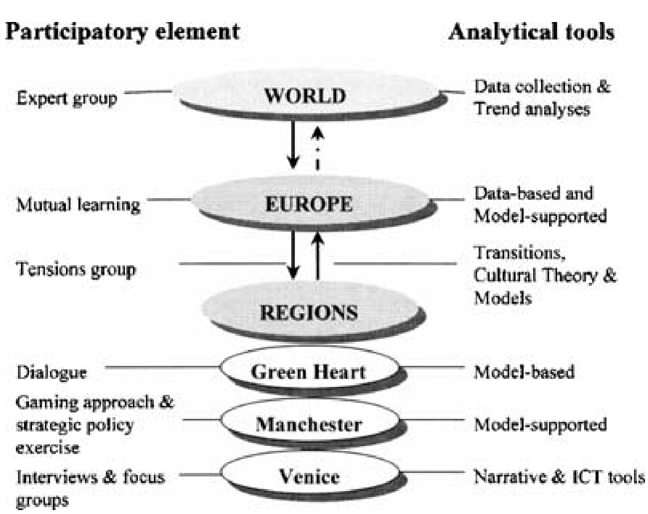

Fig. 3. The VISIONS integrated assessment framework. Source: Rotmans et al. [21].

3.2. Participatory Integrated Assessment

In contrast to the impressive development accomplished in integrated assessment modeling, participatory integrated assessments are lagging behind. Several activities have produced surveys of existing participatory methods. In addition to the illustrative and admittedly incomplete review by Toth and Hizsnyik [5], projects undertaken at the International Institute for Applied Systems Analysis (IIASA) [22] and at International Centre for Integrative Studies (ICIS) [23] surveyed the field and described partly overlapping lists of participatory assessment techniques.

The EFIEA science-policy workshops (see [1] for short summaries and [24] for an evaluation) largely followed the traditional conference format. Speakers and discussants made presentations, invited panel members gave their comments, and finally questions, comments, and views from the floor enriched the discussions. These science-policy workshops were undoubtedly important and useful fora for discussing options for European climate policy. The proposition nevertheless remains: it might be useful to experiment with well-established participatory techniques in the future to foster a deeper involvement of policy participants in the proceedings. A more active participation may turn out to be a distinctively different experience and it is likely to provide them with significantly more learning than working in the traditional workshop format.

One of the largest national programs on climate policy in Europe, the Climate Options for the Long term (COOL) project in The Netherlands, also included a component for science-policy interaction [25]. The COOL project entailed three different levels: global, European, and national. The global science-policy meetings [26, 27] have largely followed the traditional workshop format but occasionally organized discussion groups around an integrated assessment model or specific components of it. One example is the presentation and use of the Framework to Assess International Regimes for differentiation of commitments (FAIR) model at one of the COOL global workshops. The national component, in contrast, adopted a framework to allow for a more intense participation by policy makers. These workshops were organized on the basis of the Policy Exercise method and demonstrated the strengths and capabilities of well-designed participatory techniques to provide an intense and efficient exploratory/learning environment for policy makers.

Two other activities involved applications of the Policy Exercises approach. The first one explored the questions whether and how could the European venture capital sector promote the accomplishment of the European Union's Kyoto commitments by investing into small innovation-oriented technology development companies that are working on low-carbon, non-carbon, and energy-efficiency improving technologies [28, 29]. Pre-interviews conducted in the preparatory phase helped frame the issues and design the scenarios for use at the workshop. A set of background and briefing documents (including preliminary scenarios and a technology catalog) was also sent out to the participants in the preparatory phase. About two-dozen executives of venture capital and technology-development companies processed three scenarios at the workshop. They were debating how they would respond to alternative turns and trends of events in climate policy in Europe and globally. The comparative analysis of the results from these scenario sessions provided a series of explicit recommendations from these stakeholder groups to the national and European public policy makers regarding a favorable enabling environment for risky innovation-related investments by the private sector to help achieve the emission reduction objectives.

The other Policy Exercise activity had a more general scope. This venture explored the scope and opportunities for the finance sector to promote sustainable development in selected sectors. The workshop involved representatives of different groups of investment bankers and technology developers and helped them identify the criteria and possible strategies for lucrative investment opportunities in sustainability-related items.

All the above activities and some more have proven the applicability and usefulness of participatory techniques. The question therefore arises why projects using participatory integrated assessments are still a rarity rather than routine. Section 4 will explore this question further.

3.3. Mega-Assessments

A traditional form of integrated assessment involves a group of experts representing all scientific disciplines relevant for a specific policy problem. ‘‘Blue-ribbon panels’’ in the United States, regular statements by permanent advisory boards in many countries, or special reports by ad hoc review groups have been well-established forms of scientific input to the policy process for decades. The last three decades have seen an increasing importance of multinational and global environmental problems on the policy agenda and of the international agreements to manage them. In addition to the internal advice to support the formulation of the national strategy, there has been a growing need for international assessments to provide the best available scientific information for the international negotiations. The Intergovernmental Panel on Climate Change (IPCC) performs this role in the area of anthropogenic climate change.

The IPCC published its Third Assessment Report in 2001. Compared to the previous report, two of the Working Groups preparing the third assessment have been restructured to separate the implications of climate change from the mitigation. The scope assigned to Working Group II was limited to the impacts of climate change on sectors and regions and to the issues of vulnerability and adaptation while Working Group III was commissioned to assess the technological, economic, social, and political aspects of emissions reductions. This separation is helpful to get clear assessments of specific topics in these two domains but it makes the integration of the results and the policy-oriented synthesis rather difficult. Not surprisingly, it was a major challenge to prepare the Synthesis Report [30], the policy culmination of TAR.

The consequence of the separation of impact/adaptation and mitigation in TAR was that there was no proper place to appraise the IAM literature, one of the most dynamic areas in climate change studies since the IPCC’s Second Assessment. The irony of this situation is that IAMs were created in response to the policy needs. Back in the mid 1980s when the international conferences on climate change in Villach, Austria and Bellagio, Italy [31] attracted high-level policy attention for the first time, the policy audience encountered a rather fragmented science: results from a few, low-resolution general circulation models painting broad pictures of possible changes in temperature and precipitation, results from a small number of early impact assessments (based on projected climate under a $2xCO_2$-equivalent greenhouse-gas concentrations), most of them disregarding adaptation options and costs, and some initial cost assessments of energy-related CO_2 emissions reductions. There was an obvious demand for analytical frameworks that integrate all relevant components in a consistent manner and provide consolidated policy-oriented assessments of the various intervention options and their implications. As a result, the early 1990s saw the rise of IAMs in Europe, North America, and Japan. Three large conferences at the International Institute for Applied Systems Analysis (IIASA) in Laxenburg, Austria, projects and workshops organized by the Stanford University’s Energy Modeling Forum, by the MIT’s Global Change Joint Program, and many events elsewhere provided impetus for the community to improve and extend their models. The then available results were summarized by Weyant et al. [32] in one of the most interesting chapters of Working Group III in the IPCC SAR.

The new structure under TAR left little room for such an assessment. Some new results from IAMs are quoted in Chapters 2, 8, and mainly 10 of the Working Group III report, but this is much too fragmented and hardly an appropriate presentation of the impressive developments in the field since the SAR. The need for information about the balance between impacts/adaptation and mitigation issues is obvious: how much detrimental impact can we expect to avoid by diverting our resources to mitigation options of various sorts. Many reviewers of the successive drafts of Chapter 10 (Decision-making Frameworks) requested that, in addition to the cost estimates of mitigation efforts of different magnitude and timing, the corresponding estimates of the prevented impacts should be presented as well. Unfortunately, the scope defined for Working Group III left little room to fulfill such requests.

The attempt to build up the foundations of the Synthesis Report in the final chapters of Working Groups II and III produced limited results. Chapter 19 in Working Group II presents "Reasons for concern about projected climate change impacts" in a summary figure outlining the risks associated with different magnitudes of warming expressed in terms of the increase in global mean temperature. Largely based on IAMs, Chapter 10 in WG III summarizes the costs of stabilizing CO_2 concentrations at different levels. These two summaries are difficult to compare because the questions about what radiative forcing and climate sensitivity parameters should be used to bridge the concentration-temperature gap remains unanswered.

The Synthesis Report that has been produced on the basis of the main findings of the three working groups raises some concerns about comparability and consistency as well. It brings together statements about impacts/adaptation and mitigation along a set of nine policy-relevant scientific questions, but ignores the "pedigrees" of the information sources. The statements in the working group reports are themselves distilled from a large number of reviewed studies. The generic assumptions underlying the methods, the specific assumptions of the applications, the selected baseline values for the scenarios, and many other postulations implicit in the parameterization are largely ignored or remain hidden when the Synthesis Report attempts to bring together the main insights from the mitigation and impacts/adaptation assessments.

Since the working group structure remains the same for the next IPCC assessment, one partial remedy might be if the summary chapters of Working Groups II and III combined findings from both traditional impact and cost studies, respectively, as well as IAMs that include modules of both domains. A comparative evaluation of "traditional" (single domain) and integrated (covering both domains) studies that entail the results as well as the underlying assumptions would likely result in a better and more reliable base for the Synthesis Report. Consistency might also be fostered by assigning partially overlapping writing teams to the two summary chapters.

The provision of consistent baselines for traditional mitigation and impact/adaptation studies and for new analyses with IAMs could also be fostered by developing more generic scenarios of long-term socioeconomic development rather than "just" emission scenarios. The IPCC Special Report on Emissions Scenarios (SRES) [33] presents storylines as the broader context for the emissions scenarios and it is a more useful starting point for impacts/adaptations studies than any earlier set of emissions scenarios. Yet a lot more attention would need to be paid to the social and economic factors shaping the vulnerability and adaptive capacity of climate-sensitive sectors across the countries and continents. Such information in the IPCC Baseline Scenarios could significantly improve the internal consistency of the regional studies by eliminating paradoxes characterizing many past studies according to which a region is affluent enough to produce high CO_2 emissions but it is too poor to afford any adaptation effort. Moreover, the cross-regional comparison of impacts and adaptation opportunities would also be easier and more reliable, as was the case for the comparison of regional mitigation cost assessments with the advent of generally accepted and widely used baseline emissions scenarios, such as the IPCC IS92 series or the scenarios in SRES.

Despite the above weaknesses, the third assessment report of IPCC is a high-quality product with respectable influence in the policy arena. Given the inertia of the production cycle, however, it is necessary to think about the possible and necessary improvements for the next assessment round. Preparatory events like the Expert Meeting on Integrated Analysis of Adaptation and Mitigation and the emerging outlines for the Working Groups of the Fourth Assessment are a good start towards a proper treatment of mitigation-adaptation linkages while preserving the opportunity to devote sufficient attention to more limited integrated assessments of vulnerability and adaptation at specific locations for specific communities or sectors across a range of possible climate futures.

3.4. Organization and Community

The founding of the EFIEA-I provided a decisive impetus for activities supporting IA professionals to organize themselves into a community. The International Association for Integrated Assessment was established in 2000, thanks to the commitment and hard work by Jan Rotmans and Hadi Dowlatabadi. The Society's journal entitled Integrated Assessment has quickly become a respected and widely recognized publication channel. With the founding fathers of the Society as editors-in-chief, the journal produces a steady flow of excellent papers and stimulating special issues.

The eight issues published in the first two volumes contain high-quality papers reporting recent achievements. Yet there is a slight uneasiness as one takes a closer look at the content of the journal. It is dominated by papers about a range of IEA applications with about 90% of the papers reporting new results about climate change. A notable exception is Volume 2 Number 2 with In 't Veld [34] (as Guest Editor) that is a Dutch special issue on integrated models to bridge the gap between science and policy making. Presumably, the journal editors would welcome more contributions about the scholarship of integrated assessment. The small number of papers devoted to the concepts and methods of integrated assessment is a clear indication that this is a practice-oriented community and most members are preoccupied with their ongoing projects. Fortunately, this gap in the journal is at least partially compensated by the reports originating in the conferences organized under the auspices of EFIEA-I. Contributions to the forthcoming volumes on uncertainty and on scales are likely to be valuable for the IA community as well as a larger audience in environmental science and policy.

Another important success for the European IA community is that the European Commission provided founding for another round of the Forum (EFIEA-II). The ideas and plans presented in the proposal promise a new stage of development in the concepts, methods, and applications of IEA.

4. WHY IS PROGRESS IN PARTICIPATORY ASSESSMENTS SLOW?

In recent years, integrated assessment has become trendy and participation is undoubtedly ‘‘in’’. Accordingly, one would expect a buzzing scene of participatory integrated assessments (PIA). This is not the case. To answer why, let us step back for a moment and distinguish the two domains. Assessment is concerned with collecting and organizing data, performing analyses, and searching for options that are better than others according to some criteria. In contrast, a decision is the action to induce a change in the behavior of others by someone who is in the position to influence others' behavior.

It follows that decision analysis is a special part of the decision preparation activities in the sense that it is trying to bring the insights from the assessment closer to the social and policy context in which the decision will actually be made. A decision analytical framework can be defined as a coherent set of concepts and procedures aimed at synthesizing available information from relevant segments of the given environmental management problem in order to help policymakers assess consequences of various decision options. The framework is used to organize the relevant information in a suitable structure, apply a decision criterion (both based on some paradigms or theories), and thus identify options that are better than others under the assumptions characterizing the analytical framework and the application at hand. In the ideal case, decision analysis would consider all interests, constraints, and other intricacies of the decision-making context so that its result can be taken and directly applied in decision making. This is hardly ever the case. At best, results of decision analysis inform participants in the decision making process and are used by decision makers who need to consider and factor in a whole array of other criteria and considerations not included in the decision analytical frameworks.

The next crucial difference between assessment and decision making is related to the issue of objectivity versus values and preferences. There is some debate in the assessment community regarding whether the assessment can ever be objective and whether it should be as value-neutral as possible. Some argue that objectivity should be pursued. Others maintain that an assessment can only be useful if it clearly reflects the value choices of the client. Yet others use IAs to articulate their own or their clients' values and to support the ensuing behavioral changes. There is no such debate on the decision making side. Perceptions, values, and bare interests of different stakeholder groups brutally clash in their efforts to secure a decision favorable to them.

Another related but less debated topic is the general principle that assessments should fulfill demanding criteria of professionalism. They should incorporate the best available scientific knowledge and use the most appropriate analytical framework. This ‘‘elitist’’ mode of operation is in strong contrast with the decision making process that, as increasingly argued in recent times, should be democratic in the sense that there is a fair chance of each affected group to represent and protect their own interests.

Taking a closer look at participation, we find that, although professionalism is a necessary criterion, it should not and does not prevent the incorporation of lay or traditional knowledge. On the contrary, in recent years we witness an increasing number of efforts to make arrangements for incorporating information from realms beyond mainstream science into the assessments and directly into decision making. This calls for participation in the assessment process. However, it is not to be confused with the representation in the decision making process where knowledge input and pursuing one's interests are inseparably mingled.

The explanation is in the distinction between assessment and decision making again. The former takes place as part of the preparation for decision making, while the latter is the process and act of decision making per se. What we can observe is that the application of participatory technique in the assessment process has remained sporadic over the years, while involvement and participation of stakeholders in actual decision making procedures has been growing. This is demonstrated by numerous projects under the auspices of the World Bank [35] in many developing countries.

After this clarification, let us consider a few reasons why progress in participatory integrated assessments and in their applications has been slow and lagging noticeably behind integrated assessment modeling.

4.1. PIAs Need a Client

The need for a client for a PIA project is much more obvious than in the case of IA modeling activities. It is perfectly conceivable that a research team builds up an integrated assessment project, develops the models, obtains interesting results, presents them in learned journals, and earns the appropriate recognition in the scientific community. It is another question whether these results, although developed for use in policymaking, are ever considered and used in the policy arena. In contrast, meaningful participatory integrated assessments are inconceivable and cannot really work without a clearly identified client. And this is often an impediment. Policy makers usually have their well-established information sources and it is often difficult to break into long-standing structures and processes.

The client of a PIA must be able to define the content, must have confidence in the tool to be used to explore the content, and must also be convinced of the usefulness of the participatory exercise in the sense that the tool is suitable to improve the content by participation. The community pursuing the use of PIA techniques is yet to build up trust and a persuasive track record.

The evolution of climate policy in Europe is a good example of the risks and the still prevailing deficiencies in initiating and using PIAs. A large number of national and EU research projects and many IA activities were implemented through the 1990s. In many cases, it was entirely unclear who was the client, who wanted the results and for what purposes. An activity intended as a ‘‘participatory assessment’’ was arranged by the European Commission to inform European policy makers about the results of EU-funded climate change projects. Despite all these investments in information acquisition, the performance of EU member countries at the negotiations of the series of Conferences of the Parties (COP) to the UNFCCC was mixed, at best. Especially at the great showdown of COP6, the positions of some EU member countries on several issues turned out to be closer to the US position (highly disputed by many delegations) than to those of other EU members.

The question is thus arising: what were the sources of information for the EU negotiators and the national delegations? Was the Commission’s participatory exercise of any use to any of them? Were the delegates interested in the results of the European IA projects at all? In fact, were they interested in the results of any assessments? And the other side of the question: did the IA community deliver what negotiators needed? It could turn out to be a rather insightful exercise if political scientists and other experts took a closer look at to what extent did science ‘‘guide’’ or ‘‘serve’’ policy. Did the IA community ‘‘guide’’ policy-making by performing objective analyses and delivering their results irrespective of the preceding political declarations? Or did at least part of the IA community ‘‘serve’’ policy in the sense that they delivered results to the ‘‘liking’’ of their policy clients? A closely related and equally important question is: to what extent was the European policy making selective by favoring assessment groups results of which supported their predetermined policy directions and ignored those which did not, irrespective of the scientific quality of the assessments themselves.

4.2. PIAs are Expensive

PIA projects tend to be costly. Even if they can incorporate or build upon existing datasets, models, and other information sources, a considerable investment is needed to prepare a participatory assessment. In most cases, there is a need for a core team to organize and run the show. The costs of the preparatory activities often remain hidden in the shadow of the workshop (whatever form it takes). The success or failure of a participatory assessment is largely predetermined by the quality and intensity of the preparatory activities. These costs are topped by the often hefty travel and meeting-related costs.

Certainly, developing a new IAM is an expensive venture, too. The initial phase of model design, data collection, parameter estimation, and model testing requires considerable outlays. But after the initial investment, modifications and extensions generally involve relatively modest expenses. Participatory assessments can benefit far less from their predecessors in the design phase and incur the same magnitude of meeting costs at each repetition.

4.3. PIAs are Time Consuming

Even if a PIA project adopts a well-established method, some redesign and retrofitting is necessary. One cannot overemphasize the need for thorough preparations and these activities also take time. Based on the problem statement formulated by the client, the exercise need to be framed and reframed in dialogue with prospective participants, and finally designed according to this evolving framing. Input material needs to be obtained and meeting logistics must be prepared. After the participatory session, post-processing activities follow: the analysis of the results, various follow-up activities (e.g., post-interviews), documentation, report writing, etc. This means that it is impossible to produce significant results based on a meaningful PIA in a short time. Therefore, PIAs cannot help policymakers in an ad hoc manner.

Here again, development of a new IAM from scratch can take years even for a competent and experienced modeling team. But once the model works reliably, new runs on the basis of modified assumptions and scenarios can be produced in a matter of hours or days. Accordingly, results and a short summary report can be made available to policy makers at short notice. In contrast, even under ideal circumstances (small, relatively homogeneous, eager and committed participants, straightforward procedural design, ready availability of input material and project team), a participatory enterprise would take at least two-three months to complete.

4.4. PIA Should be Repetitive

Very few complex policy issues requiring participation of the affected stakeholders in the assessment process can be resolved in one round. Experience shows that increasing returns to scale can be realized by investing in subsequent rounds of repeating somewhat modified versions of a participatory assessment. Nevertheless, most PIA projects tend to be one-shot events and this potential is lost. One notable exception is the COOL project of the Dutch Climate Policy Program [36] that was furnished with sufficient resources and was given enough time to arrange and benefit from repeated rounds of participatory assessments.

4.5. General Difficulties

One can add to the above list the usual difficulties of involving policy makers into any type of meeting outside their peer circles. In addition to their busy schedules and the diversity of their commitments, perhaps the most difficult impediment to overcome is their fear of ‘‘losing face’’. Policymakers can be afraid of making statements that does not satisfy some strong pressure groups or, in general, they can be worried about their statements being quoted outside the meeting room.

One more reason for the low popularity of PIAs in Europe might stem from the cultural disposition of possible policy participants and the related deficiency in especially higher education. In the United States, games, simulations, role-playing exercises, and other participatory education techniques are widely used at colleges and universities. Most universities in Europe still consider these forms of education ‘‘unserious’’ and do not provide much opportunity to their students to gain experience with participatory techniques. The notable exception is the young generation of MBAs because modern management schools increasingly use such techniques.

To summarize the current state of affairs in PIA in Europe, a client must be very determined or rather desperate to venture into a PIA project. Moreover, the client must be in the position to attract peers from the relevant stakeholder groups otherwise the venture remains incomplete and the results have only limited value.

5. NEW CHALLENGES AND OPPORTUNITIES

The work program for EFIEA-II provides a comprehensive inventory of tasks facing the integrated assessment community. This section presents a rather selective list of items that seem to be important candidate topics to be addressed by the IEA specialists over the coming years. The challenges and opportunities are presented in three groups. In addition to the thematic and methodological items, we first look at issues of general interest to the IA profession.

5.1. The Integrated Assessment Profession

Despite the progress and achievements in IEA presented in Section 3, self-identification of the IA profession is still unresolved. Views tend to diverge about what are the distinctive features of integrated assessment and what is new about it at all. Consider one arbitrarily selected example from a book published in the early 1980s [37]. It originates in a project concerned with water quality management in shallow lakes. Figure 4 presents the main items of the study. Even a cursory look at the figure makes it evident that this project would qualify as an integrated assessment activity today. It incorporates all important physical, biological, and chemical processes, anthropogenic forcing, management options and optimization to support decision-making. This effort was simply called applied systems analysis twenty years ago.

The origins of systems analysis, in turn, can be traced back to operations research [38]. The latter started in 1935 and it was mainly concerned with the operation of systems of which people are part. By the 1950s, the application of operations research was extended to large systems. It became necessary to bring in specialists from many disciplines and the term ‘‘systems analysis’’ emerged from this process. The emphasis was still on operating systems, already existing or still in the planning phase. Over the following two decades, the field of systems analysis was growing both in scope and diversity and more names were invented to distinguish among the styles and areas of applications: operations research, operation analysis, policy analysis, policy science, systems research, and other similar names were used to delineate different arrays of systems analysis. The general objective nevertheless remained the same: systems analysis sought solutions to problems of operations, planning, and policy. Its success led to the establishment of the International Institute for Applied Systems Analysis (IIASA, Laxenburg, Austria) in 1972 with the assignment to address international and global problems by using the tools of systems analysis.

A closer look at systems analysis makes its intimate relation to what is today called integrated assessment rather evident. Systems analysis is primarily concerned with structures, i.e., with systems involving people and their (natural) environment. Let us take the problem of food safety and possible interventions to reduce mortality and morbidity from food contamination as an example. The starting point is the operation of the land use, water, and food production systems but the problem also includes actors, technologies, and circumstances as diverse as the farmers (with their technological capabilities and agronomic practices), their suppliers of input factors (seeds, fertilizers, pesticides, machinery), the full vertical complex of the food processing industry, wholesale and retail trade, the customers themselves, the rules and customs of food preparation and storage, the cultural conditions that influence to what extent they are followed, and the surrounding environment (including the weather, direct and indirect competition in the different market segments, and so on). Many of these systems elements display regular behavior and as such, they can become the object of scientific observations from which knowledge can be derived. Systems analysis applies this knowledge by using logical tools of science with the declared purpose to help decision makers manage their problems and make policies. The vehicle is to generate information regarding the problems and the options to solve

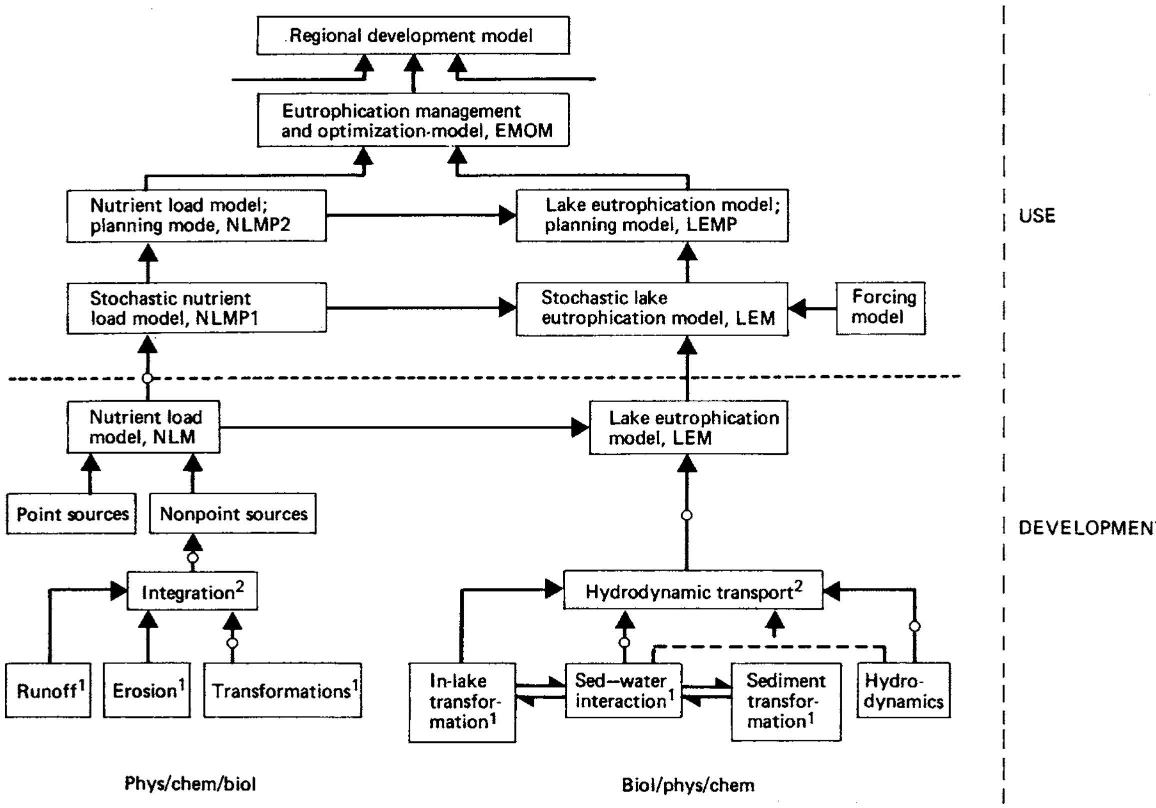

Fig. 4. A systems analysis model of the Lake Balaton shallow lake eutrophication problem. Source: Somlyódy, L. and van Straten, G. [37].

them by focusing on interactions of society, enterprises, and the environment. The product of the systems analysis activity is a set of responses to the problems including their implications.

Over the past half century, systems analysis has been applied to a wide range of problems. The systems incorporate many elements and phenomena dispersed across space and time. Many variables interact and this results in complex problems. The solution functions describe not only the resolution of the original problem but also their side effects. Many decision makers, stakeholders, and constituencies are affected and uncertainties are abundant in the scientific input and in inputs related to social choice.

The problem characteristics and the difficulties in systems analysis include inadequate knowledge and insufficient data, the inadequacy of existing approaches, the large number disciplines involved, unclear or outright controversial goals, and shifting objectives of the affected stakeholders, pluralistic responsibilities for making and implementing the decisions, and the general resistance to change in social systems. Systems analysis accomplishes some general features and characteristics in facing these challenges. They include the context: usually complex problems arising from a large diversity of interactions among many systems constituents. The relevant methods must serve understanding, invention, analysis, design and intuition. The tools applied in systems analysis originate in logic, statistics, mathematics, technology and the sciences. The aim is to assist in finding responses to problems, i.e., decisions and specific actions. The clients include the responsible public and private decision makers. A continued interaction between the analysts and the clients is crucial. It follows that systems analysis can be conceived as a sort of engineering. It is the invention and design of applying scientific methods to complex problems. Therefore, some of its prominent representatives maintain that systems analysis itself is not a science. Although there are some theorizing elements, the emphasis is on choosing and acting [38].

None of the above statements, objectives or characteristics of systems analysis would contradict to a broadminded definition and interpretation of integrated assessment. Systems analysis and IAs are both multidisciplinary, problem-solving activities to address complex problems in public and private organizations. They are both based on foundations provided by specialists. In fact, systems analysis is very much alive. There are journals, societies, conferences, and many companies making a living by using systems analysis to solve clients' problems.

As experience in integrated assessment activities accumulates, it might be useful to engage into a new round of self-identification. What are the distinctive features of integrated assessment that can tell it apart from applied systems analysis. What are the conceptual and methodological differences between these two large fields. A serious attempt to answer these questions is much more than just an unproductive, speculative exercise. Unambiguous self-identification could foster future development of the IA profession in general. A clear distinction could guide possible clients regarding what they should or should not expect from integrated assessors as opposed to practitioners in other areas.

A critical appraisal of integrated assessment projects completed over the past few years could also help disentangle the ingredients of success and the reasons for failure in IA. Whatever will be the resolution of the self-identification exercise, integrated assessment remains an interdisciplinary effort. Some general criteria for success in interdisciplinary research (partly based on the list of Jacoby [39]) include the following. There must be a shared research aspiration for the assessment team as a whole. Team members should respect each other's disciplinary expertise to ensure an inspiring and effective group dynamics atmosphere. The contribution of each team member should have value for the member's own disciplinary progress. The more general criteria for IA success include value for society and policy making. It is helpful to locate the IA activity at a recognized host institutions or around an acknowledged personality. Financial support is a delicate issue. Generous sponsoring, attentive and receptive clients are important but one should avoid customer-type relationships in which not only the project but the results are ordered as well. A critical appraisal of recent projects against these criteria might be helpful for the self-identification and also for better design and implementation of future integrated assessment projects.

In addition to the above general list, there are some additional considerations more specific to IAs. As an ongoing activity, the process of IAs is at least as important as the product. The objective is to improve understanding rather than pursuing the right decision. The assessment portfolio should combine models, desk studies, and participatory techniques according to the characteristics of the problem at hand. Timeliness of IA activities means providing the answers when the question is asked. This requires that IA professionals track and project the evolution of issues in the policy arena and attempt to foresee the emerging questions. Here again, a critical evaluation of earlier projects along these points might produce a rather useful guidance for future efforts.

5.2. Thematic Challenges and Opportunities

The most widely used and most heavily debated concept in environmental research and policy in recent years has been sustainability. Curiously, the origins of the sustainability debate can be traced back to a well-defined area of applied systems analysis called global modeling. In the early 1970s, an increasing number of large-scale global problems entered the policy agenda: fast population growth, fear of food and energy shortage, and increasing environmental degradation. The background of these concerns was the escalating integration of national economies in trading blocks and their incorporation into the world economy. This process was characterized as increasing global interdependence involving many factors, actors, and domains in a complex web of relationships. It is simply called globalization today. Systems analysis emerged as the pertinent tool to address these problems. The first and most famous global model was produced at the MIT based on the modeling paradigm and tool of systems dynamics developed by Jay Forrester.

The world model and its results published in the book *The Limits to Growth* [40] anticipate a rather bleak future for the world: if present trends continue, scarcity, degradation, poverty, crisis, and collapse are looming. The core concept of the underlying model is exponential growth and it is the root of all bads. The report triggered an enormous debate about economic growth, general socioeconomic development, and their implications for natural resources and the environment. Part of the debate was focusing on zero growth. Not surprisingly, zero growth was totally unacceptable to poor countries, in fact for any country. A new concept has emerged in the debate based on the principle that development (and economic growth as its basis) is indispensable but it must be environmentally benign. The term sustainable development has become a buzzword after the publication of the report prepared by the World Commission on Environment and Development [41]. The definition proposed by the World Commission (satisfying the needs of the present generation without compromising the ability of future generations to satisfy their needs) is generally accepted but void of any practical guidance.

Endless debates over the past fifteen years have been desperately trying to find out the practical implications of the sustainability concept. Dozens of alternative definitions, hundreds of sustainability indicators, numerous criteria and implementation strategies have been proposed. Most of these contributions are based on what could be classified as systems analysis or general purpose integrated assessment. The reason why it looks difficult to define precise criteria for sustainability is that it involves value judgment. What would one consider sustainable? For whom? By whom? In what context?

A new wave of the sustainability discussion has been triggered by Kates et al. [42]. The authors maintain that, following the alienating political pretense for over a decade after the publication of the WCED report, foundations are shaping for rigorous scientific investigation of the essential features of the interactions between humanity and the natural environment. They define a set of core questions concerning the scales and dynamics of nature-society interactions, vulnerability and thresholds of the joint system, and about the options, information and decision-support requirements for managing it. They also propose research strategies to tackle these questions that resonate very well with the objectives and capabilities of IEA. In their response to Kates et al., Swart et al. [43] extend the list of challenges and propose additional strategies to pursue, like participatory scenario development. Considering the widely diverging views about sustainability even within single disciplines, there will be a long way and a lot of debate until consensus may emerge about its more specific definition and practical implications. A crucial feature of the problem is that the term is politically heavily loaded. It is widely used and often misused in the political arena.

The IA concept and methods could obviously contribute to clarifying the meaning of sustainability and help operationalize the criteria for sustainable development strategies. Participatory techniques might help identify the hidden interests and often veiled political agendas behind the competing propositions and move the debate towards consensus by identifying the generally acceptable minimum set of criteria. The key practical question remains whether sustainable development is a program to implement or it is a general principle to adopt in implementing all other programs.

A closely related concept, often used in environmental policy formulation, is the precautionary principle. Concern that the large uncertainties associated with the management of ecosystems (and environmental resources in general) and related human well-being will lead to long delays in decision-making and management response has led to increased use of the precautionary principle. As defined in Principle 15 of the 1992 Rio Declaration, this means that ''[w]here there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation'' [44]. A variety of versions of this principle are now in use, with differing implications for environmental assessment and decision-making. Some commentators view the precautionary principle as an alternative to risk analysis, while others regard it as an ethical principle for particular decision situations.

The resemblance between the cases of sustainability and the precautionary principle holds even for the debate part. While precaution is generally accepted as an approach to managing environmental problems, the precise meaning and practical implications of the precautionary principle remain subject of fierce debates. Here again, integrated assessment seems to have the potential to advance the debate and help operationalize this important concept.

5.3. Methodological Challenges and Opportunities

Although it is building on long traditions of related fields like operations research or systems analysis, integrated assessment as such is still a new area. This means there is lot of work to do in developing new methods and tools both in the modeling and in the participatory domains.

In the field of modeling, newly emerging problems on the policy agenda require innovative concepts and the development of new analytical frameworks. These frameworks will trigger the elaboration of new techniques for integration. Modern software technology offers a flexible and efficient environment for developing new generations of IAMs. Networking and Internet-based technologies enable IAM developers to build and operate their models from geographically remote locations. The group of outstanding IA modelers gathered in EFIEA-II might conduct interesting experiments by using these advanced technologies to develop innovative IA modeling approaches.

New participatory assessment methods and improved versions of existing techniques could be developed by capitalizing on recent developments in several social science disciplines. Small-group techniques in social psychology, behavioral sciences, and sociology, new approaches in experimental economics, and advances in simulation-gaming can all contribute to the arsenal of IAs. Despite all these improvements and the increasing inventory of potential resources, the design and implementation of a PIA project remains a major challenge. Most professionals in the field have built up their expertise in ''learning by doing'' in many projects and over many years. Their experience should be of sufficient quantity and quality by now for producing a tutorial for young professionals. A special problem area is facilitation. The difference between excellent and poor facilitation might make the difference between success and failure of the participatory project. Yet there is no place to train PIA facilitators and hardly any opportunity for low-risk practice.

Given the diversity of the problems and contexts in which IAs are adopted, it is impossible to provide custom-made training for practitioners of participatory techniques. Nonetheless, it is likely that in order to make use of the full potential of these techniques, some forms of training in participatory procedures should be initiated, perhaps under the auspices of EFIEA-II.

6. SUMMARY AND CONCLUSIONS

This incomplete and deliberately selective survey of the IEA scene shows a mixed record. We witness impressive progress in IA modeling: new topics are embraced and new analytical frameworks are developed to address problems with special characteristics. There are also promising efforts to combine scenarios, modeling, and participatory techniques. We can see some timid steps and a limited number of new efforts, but hardly any progress in developing and applying participatory techniques. The IA community is still searching for its self-identity: what are the distinctive features that separate IA from operations research, applied systems analysis, and other related areas. Similarly, the IA community is searching for its role in the European policy process. Climate change assessments and policy formulation can be characterized by paraphrasing Luigi Pirandello: a dozen of IAMs are searching for an audience.

The most prominent mega-assessment completed recently, the Third Assessment Report by IPCC, certainly fulfilled its mission and resulted in a high quality appraisal of the state-of-the-art in the scientific understanding and management options of the climate change problem. Yet it was a setback for IA, because the rigid separation of impacts/adaptation and mitigation topics did not permit the critical appraisal and appropriate presentation of the insights from integrated assessment models encompassing both domains. Preparatory activities indicate that this will not be a problem in the Fourth Assessment Report.

Making advances in the participatory assessments remains a challenge. A diverse array of tools exists and their usefulness already demonstrated but the trust and funding for further applications are still difficult to obtain. The features discussed in Section 4 of this paper produce highly uncertain benefit-cost and benefit-risk ratios for the applications of participatory technique in any assessment project. A larger group of well-trained professionals could tilt these ratios in the favorable direction, but hardly any opportunity is available for education and practice.

The IA community is facing a number of serious challenges. In addition to the question of self-identification, the issue whether professional standards are relevant at all is still unresolved because many practitioners maintain that IAs will always rely on some intuitive elements and will therefore always be as much an art as a science. In addition to the contribution to solving the numerous environmental issues on the sociopolitical agendas, IAs could play a useful role in the new wave of the sustainability debate, in developing sustainability science, including the operationalization of the precautionary principle, and exploring their practical policy implications.

The unquestionably good news is that, thanks to a number of devoted individuals, significant progress has been made in organizing the IA community. The foundation of the International Association for IA, the establishment of its journal, and securing funding for EFIEA-II set the stage and provide the opportunity for further advances. Yet these valuable frameworks will need to be filled with high-quality content if integrated assessment is to realize its great potential and contribute to effective, socially equitable, economically efficient, and politically feasible environmental policies in Europe and elsewhere.

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