Bridging Scales and Epistemologies in the Millennium Ecosystem Assessment

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Abstract

In response to lessons from previous international assessments and in light of unique features of ecosystems and their management, the Millennium Ecosystem Assessment was designed as a multi-scale assessment and has established mechanisms to incorporate information and knowledge from non-peer-reviewed sources including local and traditional knowledge. This paper briefly reviews the rationale for the MA, and describes the multi-scale and multi-epistemology features of the MA, the rationale for those features, and the challenges being encountered in their implementation. In particular, the paper explores: i) the definition of scale within the MA, noting that the distinguishing features of the different scales of the MA appear now to involve principally the scale of authority of the users of the assessment rather than the scale of analysis of the system; ii) mechanisms to overcome barriers to effective cross-scale interactions among assessments; iii) the fundamental challenge of undertaking an assessment that is viewed as credible, legitimate, and salient in different epistemological contexts; and, iv) the tensions -- as well as complementarities -- that exists between "getting it right" (as through the creation of a multi-scale, multi-epistemology, multi-sectoral assessment) and "making it relevant" (as for example to traditional single-scale, single-epistemology, single-sector users).

Introduction

The Millennium Ecosystem Assessment (MA) is designed to meet the needs of decision makers and the public for scientific information concerning the consequences of ecosystem change for human well-being and options for responding to those changes. The MA was launched by U.N. Secretary-General Kofi Annan in June 2001 and it will help to meet assessment needs of the Convention on Biological Diversity (CBD), Convention to Combat Desertification (CCD), the Ramsar Convention on Wetlands, and the Convention on Migratory Species (CMS), as well as needs of other users in the private sector and civil society. If the MA proves to be useful to its stakeholders, it is anticipated that an assessment process modeled on the MA will be undertaken every 5–10 years and that ecosystem assessments will be regularly conducted at national or sub-national scales.[1]

The MA focuses on ecosystem services (the benefits people obtain from ecosystems), how changes in ecosystem services have affected human well-being, how ecosystem changes may affect people in future decades, and response options that might be adopted at local, national,

[1] For additional information, see http://www.millenniumassessment.org)

or global scales to improve ecosystem management and thereby contribute to human well-being and poverty alleviation. (See Figure 1.) The specific issues being addressed by the assessment have been defined through consultation with the MA users.

The MA was established in response to demands from both policymakers and scientists. By the mid-1990s, many individuals involved in the work of international conventions such as the Convention on Biological Diversity (CBD) and the Convention to Combat Desertification (CCD) had come to realize that the extensive needs for scientific assessments within the conventions were not being met through the mechanisms then in place. In contrast, other international environmental conventions such as the Framework Convention on Climate Change and the Vienna Convention on Substances that Deplete the Ozone did have effective assessment mechanisms – the Intergovernmental Panel on Climate Change (IPCC), and the Ozone Assessment – that were proving to be important assets to these treaties.

The IPCC, for example, has now published three assessments (each consisting of three 800-page volumes) and multiple syntheses and special reports, and is widely recognized for its role in bringing the 'state of knowledge' concerning climate science to bear on the needs of decision-makers worldwide. Journalists can always find a 'naysayer' to quote, but news articles now typically note that "The IPCC, involving the majority of the world's leading climate scientists, has concluded …". The Ozone Assessment is similarly regarded as the gold standard of scientific information to guide decision-making concerning the causes and consequences of ozone depletion and policy options for addressing the problem.

The scientific community was also encouraging the establishment of an IPCC-like process for biodiversity and ecosystems during the 1990s in the belief that the urgency of the problem of ecosystem degradation demanded such an assessment and that major advances that had been made in ecological sciences, resource economics and other fields during the 1980s and 1990s, were poorly reflected in policy discussions concerning ecosystems (Reid, 2000; Ayensu et al., 2000; Clark et al. 2002). Moreover, the scientific community was concerned that the then existing 'sectoral' assessments (focused on climate, ozone, forests, agriculture, etc.) were insufficient to address the interlinkages among both environmental problems and their solutions. In November 1998, the report *Protecting our Planet, Securing our Future: Linkages Among Global Environmental Issues and Human Needs* prepared by a panel of 40 leading scientists was released and called for "a more integrative assessment process for selected scientific issues, a process that can highlight the linkages between questions relevant to climate, biodiversity, desertification, and forest issues" (Watson et al., 1998).

The MA was designed between 1998 and 2000 by an Exploratory Steering Committee established by World Resources Institute, United Nations Environment Programme, United Nations Development Programme, and the World Bank, that included representatives of international ecosystem-related conventions (including several past chairs of the scientific subsidiary body of the CBD), international agencies, scientists, and NGOs. The work of this Steering Committee was influenced both by the success of the IPCC and the failings of one previous attempt to create an IPCC-like process for biodiversity: the *Global Biodiversity Assessment,* published in 1995 (Heywood and Watson, 1995). The *Global Biodiversity Assessment* was a 1100-page report prepared by leading biodiversity scientists and it is still used as a reference by many scientists. The GBA was intended to serve as an IPCC-like assessment for the Convention on Biodiversity (CBD), but the parties to the convention rejected the report before the work even began and in the end refused to receive or use its findings. Partly because the report was prepared without any dialogue with its intended

users, it focused more heavily on scientific debates than on debates with policy implications. In addition, the GBA lacked internal consistency and synthesis, which critically limited the likelihood that any of the relevant data and information it contained might become the focus of continuing monitoring or repeated measures (Reid and Mace, 2003).

What makes a process like the IPCC succeed in bringing cutting edge science to bear on decision-making? The Harvard Global Environmental Assessment Project concluded that three factors underlie successful global scientific assessments (Clark and Dickson, 1999):

First, they are scientifically credible. The IPCC involves thousands of scientists as Coordinating Lead Authors, Lead Authors, Contributing Authors, Chapter Review Editors, and Expert Reviewers. All of the IPCC assessment reports undergo two rounds of review by governments and experts with more than 50 sets of review comments received per chapter. IPCC focuses both on what is known with certainty by the scientific community and what remains uncertain. The IPCC is now the authoritative source of information on climate science.

Second, they are politically legitimate. An assessment is far more likely to be used by its intended audience if that audience is fully 'bought in' to the process. In other words, if the intended users requested the assessment, had a role in the governance of the assessment, were involved in its design, and had the opportunity to review and comment on draft findings, then they will be far more likely to make use of the results. It is all too easy for users to simply ignore the findings of an assessment, no matter how good the science, if they were not part of the process of establishing or undertaking the assessment. (The GBA is a case in point.) Governments authorized the IPCC and ultimately approve the findings line-by-line. Scientists from more than 100 countries are involved as authors and reviewers.

Finally, successful assessments respond to decision-makers' needs. This is not to say that scientists do not have an opportunity to introduce new issues and findings that decision-makers need to be aware of – they do. But the priority for the assessment is to inform decisions that are being faced or soon will be faced by decision-makers

The MA was designed to meet these three criteria – credibility, legitimacy, and utility. To achieve the standard of credibility, the MA follows almost identical procedures for preparation and review as used in the IPCC. A team of globally known social and natural scientists co-chair the scientific working groups and leading scientists from around the world serve as Coordinating Lead Authors and Lead Authors. An independent Peer Review Board has been established to oversee the review process. In the end, more than 2000 authors and expert reviewers are likely to be involved in the preparation and review of the MA.

To ensure the legitimacy of the process, the MA Exploratory Steering Committee decided not to even proceed to establish the assessment until and unless there had been a formal request for such an assessment from governments. Four international conventions (CBD, CCD, Ramsar Convention, and CMS) have now taken decisions in their Conferences of Parties authorizing the MA as a source of assessment input. Like the IPCC, all of the MA Working Groups are co-chaired by developed and developing country experts, and involve a geographically balanced group of authors. The Secretary General of the United Nations has stated that "The Millennium Ecosystem Assessment is an outstanding example of the sort of international scientific and political cooperation that is needed to further the cause of sustainable development." (Annan, 2000)

To meet the standard of utility, extensive consultations have been made with intended users in governments, the private sector, and civil society, including reviews of several drafts of an outline of "user needs" and review of the outlines of the assessment reports. In addition, some of the intended users such as the CBD have made formal requests for specific types of assessment input.

Rationale for a Multi-Scale and Multi-Epistemology Assessment

When the idea for the MA first arose in early 1988, it could have been accurately described to be an "IPCC for Ecosystems and Biodiversity." Today, while the strong influence of the IPCC is still readily apparent, the MA differs in structure from the IPCC in four important respects:

a) the MA has a multi-stakeholder governance arrangement while the IPCC is strictly intergovernmental;
b) the MA user audience is defined to include governments, the private sector, and civil society, while the formal audience for the IPCC is only governments (although its findings are used by others);
c) the MA is a multi-scale assessment, while the IPCC is a global assessment which increasingly incorporates regional analyses; and,
d) the MA has established a mechanism allowing use of both published scientific information and traditional, indigenous, and practioner's knowledge, while the IPCC uses only published scientific information (peer reviewed and gray literature).

The basic rationale for all four differences relates to the nature of ecological process and to the locus of authority for decisions affecting ecosystems. (Although, on closer examination, the same rationale that justify these features for the MA could apply to some extent to virtually any other assessment examining either environmental issues or policy responses to environmental change.) Climate change is the classic example of a global environmental change. Although there is considerable local specificity to the causes of emissions of greenhouse gases, once those gasses are emitted they quickly mix in the atmosphere. The increased greenhouse gas concentrations in the atmosphere will have a global impact in the sense that all countries are affected by this change (although again, the local impacts differ from region to region). And, decisions taken to address the problem must have a strong global component. With the technologies currently available, steps taken by one country to control greenhouse gas emissions could place it at a competitive disadvantage without reducing the risk of climate change if other countries did not take similar steps.

In contrast, while ecosystem change and biodiversity loss is of global environmental concern, and while there are global dimensions to the problem and its solutions, the sub-global dimensions are often of much greater significance. Consider aspects of the causes of change in biodiversity and ecosystems, the impacts of those changes on people, and the potential responses to those change:

a) Causes of ecosystem change. Factors affecting ecosystems include drivers with global impacts such as climate change and species introductions, regional impacts such as regional trade or agricultural policies, and local impacts such as land use practices and the construction of irrigation systems.

b) Impacts of ecosystem change. Changes to ecosystems can have global consequences such as the contribution of deforestation to climate change; regional consequences such as the impact of nutrient loading in agricultural ecosystems on coastal fisheries production; and local consequences, such as the impact of overharvesting or land degradation on local food security.

c) Responses to ecosystem change. Policy, institutional, technological, and behavioral responses to ecosystem-related issues can involve global actions such as the creation of the Global Environment Facility to provide financial support to biodiversity conservation and sustainable use around the world; regional action such as regional agreements for wetlands conservation for migratory bird protection; and local responses, such as a decision by a farmer to alter land management practices to conserve topsoil.

Indeed, the sub-global dimensions of the ecosystem-related issues are strongly reflected in the international treaties concerning biodiversity and ecosystems themselves. The CBD, for example, is to a large extent a framework convention, providing global standards, setting norms of conduct, and establishing global targets, but not requiring any particular actions by countries other than administrative steps such as preparing national biodiversity strategies and action plans. Although political and sovereignty concerns also drove this arrangement, the fact is that there are relatively few 'global' decisions that will have a major influence on the conservation and use of biodiversity. The decisions that will ultimately matter the most will be those taken by private companies, national governments, and individual land owners and land managers.

In light of this multi-scale nature of both the issues involved and the decisions being made, early in the exploration of the idea for the MA it became clear that a strictly 'global' assessment would be insufficient. Assessments at sub-global scales are needed because ecosystems are highly differentiated in space and time and because sound management requires careful local planning and action. Local assessments alone are insufficient, however, because some processes are global and because local goods, services, matter, and energy are often transferred across regions (Ayensu et al., 2000).

Moreover, it was equally clear that the important decisions affecting ecosystems would not be only those taken by governments. Private companies, for example, manage extensive amounts of land and their decisions could in many cases be far more significant than governmental decisions. Similarly, if an assessment was to be conducted that was intended to contribute to decision-making at multiple scales, then the involvement of civil society organizations would be essential both to help focus the assessment on relevant issues and to help ensure that the findings were made available to users in a form that they could use.

Given these considerations, if the MA was to be scientifically credible, then it could not focus only on the global dimensions of environmental change but needed also to examine local and regional processes and this factor weighed in favor of a multi-scale design. If the MA was to be seen as legitimate by its intended audience and that audience, while including governments, also included the private sector and civil society, then it should involve those other stakeholders in the process and this factor weighed in favor of the multi-stakeholder governance arrangement. And if the MA was to be seen as useful for its intended audience, then it both needed to engage these multiple stakeholders and also provide information for

them relevant to the decisions that they were facing and typically those decisions were being taken at sub-global scales, again favoring a multi-scale design.

These same considerations also caused the MA Exploratory Steering Committee, and later the Sub-Global Assessment Working Group, to re-think the question of what type of knowledge should 'count' in an ecosystem assessment. The IPCC requires that information included in the assessment be from published (or *in press)* peer reviewed sources although it has established a mechanism for the inclusion of material from the gray literature (IPCC 1999).[2] In the case of the MA, particularly if the assessment were to be undertaken at multiple scales, the relevance of non-published information was even greater than for the IPCC. For example, at the scale of an individual village, much of the knowledge concerning trends in ecosystems, impacts of ecosystem change on people, and potential responses to ecosystem change, will often be held by the members of that community and, if published at all, the information is unlikely to have been published in a scientific journal. The IPCC relies primarily on peer-reviewed information in order to ensure its credibility. But for the MA to be credible at all scales, then it is forced to <u>not</u> rely only on published peer-reviewed information. If a local assessment is to have any credibility at all for local decision-makers, then clearly it would make no sense at all to use only the limited published information bearing on the conditions in a particular village when much better knowledge existed within the community itself.

Moreover, considerations of the legitimacy of the process also forced the reconsideration of policies for what sources of knowledge should be included in the assessment. Legitimacy can be conferred on a process in part through formal mechanisms (e.g., the involvement of particular stakeholders in governance roles) but there are many other less tangible elements involved in any particular stakeholder's decision about whether a process is legitimate and sufficiently trusted to be of use in their own decision-making. For a government official, such considerations might involve whether or not the government formally took a decision (e.g., through a convention) requesting the assessment; whether or not scientists from that county are involved in the assessment; and whether or not the government has an opportunity to review the draft findings and have their comments incorporated. But since the MA choose to address multiple audiences including the private sector and civil society, an important question becomes: what is needed for those other audiences to consider the process to be legitimate?

Consider in particular local communities or indigenous communities. Particularly in this era of globalization, the level of suspicion and distrust of 'global' process by local communities. It is unlikely that a global assessment of ecosystems would be seen as legitimate by a local community of indigenous people in the Andes or a village in South Africa if the process excluded their own local knowledge concerning their ecosystems. For the same reason, it would be unlikely that the private sector would see the process as legitimate if there were no

[2] Because some information needed by the IPCC, such as information about the experience and practice of the private sector in mitigation and adaptation activities, is found in sources that have not been published or peer-reviewed (e.g., industry journals, internal organizational publications, non-peer reviewed reports or working papers of research institutions, proceedings of workshops etc), in 1999 IPCC established procedures for inclusion of these materials. Authors who wish to include information from a non-published/non-peer-reviewed source are requested to: a) critically assess any source that they wish to include; and b) send a copy of the material to the Working Group Co-Chairs along with the names of individuals who can be contacted for more information about the source.

provisions for including information and knowledge concerning ecosystem management held in the private sector by virtue of the fact that the information had not been published.

Scale within the MA

The MA's multi-scale design called for a number of sub-global assessments to be carried out at different scales ranging from local to national to regional. Each of the MA sub-global assessments was expected to apply the MA's conceptual framework and approach on-the-ground. The primary purpose of each sub-global assessment was to better meet decision-makers needs for assessment information related to ecosystem services in the regions and at the scales where these assessments were conducted. At the same time, given the rationale introduced above, the findings of an assessment conducted at any scale within the MA should be enhanced through the information and perspectives provided by assessments conducted at larger or smaller scales. The sub-global assessments also provide other benefits to the overall MA process, by helping to build capacity to undertake integrated ecosystem assessments and by strengthening the outreach of the MA findings in the regions where the assessments were conducted.

After an open solicitation of proposals for assessments in 2000, an expert group recommended that the MA seek to establish clusters in Southern Africa, SE Asia, Europe, and Central America (MA, 2001), the MA Board approved this regional focus at its first meeting in July 2001, and planning workshops were held in each region in 2001 and early 2002. By the time of the February 2002 meeting of the MA Board, only one of these regions – Southern Africa – was in the process of successfully launching a cluster of assessments. Sub-global participants in the MA design meetings and the co-chairs of the MA Sub-Global Assessment Working Group were by then arguing that a 'bottom-up'

Box 1. MA Sub-Global Assessments

Approved Assessments

Altai-Sayan Ecoregion
Alternatives to Slash-and-Burn (ASB) sites
Caribbean Sea
Coastal British Columbia, Canada
Downstream Mekong wetlands, Vietnam
India local villages
Laguna Lake Basin, Philippines
Northern Range, Trinidad
Norway
Southern Africa (SAfMA)
Papua New Guinea small islands
Portugal
Salar de Atacama, Chile
Sweden local
Vilcanota region, Peru
Western China (MAWEC)

Associated Assessments

Arab Region Millennium Ecosystem Assessment: Supporting Decision Making for the Sustainable Use of Ecosystems
Biodiversity, Local Knowledge, and Poverty Alleviation: Sinai Sub Global Assessment
Arafura and Timor Seas Sub Global Assessment
Indonesia Sub Global Assessment
Sao Paulo City Green Belt Biosphere Reserve Assessment
Local Ecosystem Assessment of the Higher and Middle Chirripo River Sub-Basin Cabecar Indigenous Territory of Chirripo, Costa Rica
Ecological Function Assessment of Biodiversity in the Colombian Andean Coffee-Growing Region
Assessment of the Central Asian Mountain Ecosystems
The Great Asian Mountains Assessment
Fiji Sub Global Assessment
The Upstream River MA of the Great Rivers, Northwest Yunnan, China
Environmental Service Assessment in Hindu-Kush Himalayas Region – Trade-offs and Incentives
The Pampas of Argentina
The Northern Highland Lake District, Wisconsin
Trade, Poverty and the Environment in the Sunderbans Region of West Bengal
Northern Floodplains of Australia

process of establishing the assessments would be more effective, suggesting that it would be more effective to use MA funds as 'seed grants' for a larger number of assessments. Those assessments could then seek their own larger grants from sources other than MA, resulting, it was hoped, in a better levering of MA resources and more solid grounding of the assessments in regions where there was the greatest interest among donors and experts.

The MA now includes 16 "approved" sub-global assessments (See Box 1), which became full components of the MA according to criteria and guidelines approved by the MA Board (see: http://www.millenniumassessment.org/en/products.aspx.) Approximately ten of these are expected to be completed by the end of the formal MA project in March 2005, with one to be completed in 2006 and the timing of the remaining five uncertain due to funding needs. In addition to the approved assessments, 16 "associated assessments" are affiliated with the MA process. These assessments do not strictly conform to the selection criteria for approved assessments but can benefit from their associated with the MA and in turn provide valuable input into the MA process.

The MA sought to include an array of assessments that encompassed many different types of ecosystems and were geographically well-distributed around the world. However, because the process relied on a 'bottom-up' generation of assessment proposals, and because the donor funds available to support the establishment of assessments could only be used in developing countries, there was only partial control over the final distribution of assessments. In the end, the coverage of the assessments does cover most ecosystems with the notable exception of deep water marine ecosystems and arctic and polar ecosystems. And, assessments are underway in most geographic regions, although the number of assessments in developing countries outnumber those in industrialized countries.

The MA sub-global assessments were not intended to represent a scientific 'sample' of global ecosystems. For many ecosystem processes, more accurate and consistent information is available from remote sensing data or existing global monitoring processes than could be obtained through even a far larger sample of sub-global assessments than the MA could conceive of supporting. Nor were the sub-global assessments intended to focus only on areas facing the most significant problems related to ecosystems. One assumption implicit in the MA is that better information on ecosystem services, and the consequences of changes in those services, could enhance decision-making concerning the management of ecosystems whether or not the systems are already facing serious problems of resource degradation.

Within the MA, *scale* is defined to be the physical dimensions, in either space or time, of phenomena or observations (MA, 2003). The particular emphasis of the sub-global dimension of the MA has been to incorporate assessments addressing different spatial scales of interest. And, where possible, the MA has sought to 'nest' assessments being undertaken at different scales within each other. Thus, for example, the Southern Africa Millennium Ecosystem Assessment (SAfMA) includes a regional assessment, two river basin assessments within that region, and a number of community-level assessments within those river basins (See Fig. 2).

The findings of a multi-scale assessment would be expected to differ from the findings of an assessment conducted at a single scale in several respects (MA 2001):

- The definition of the problem will change. Local community definitions of "goods and services" (or "bads and disservices") of ecosystems may differ from a global

definition. By informing a global summary with the local perspective, the global summary could be strengthened. Similarly, by informing a local assessment with the global perspectives, the local assessment could be strengthened. For example, a local assessment would not be likely to consider carbon fluxes. A local assessment conducted as part of a multi-scale assessment might consider carbon fluxes and could thereby also consider possibilities for incorporation of global financial transfers as one policy response.

- The relevance and reliability of findings will be enhanced. Sub-global assessment activities can help to "ground truth" the global findings. Aggregated global syntheses necessarily leave out sub-global details. However, when those aggregated conclusions or indicators clearly diverge from the on-the-ground reality, they can be very misleading. This issue can arise when the "best available" data used for global syntheses is in fact not sufficiently reliable.

- The nature of "plausible futures" will change. An important element of the MA process is the exploration of future scenarios of the impact of ecosystem change on people. The plausible futures that might be defined by a local community could differ dramatically from plausible futures defined at a regional scale, which might for example incorporate dramatic technological change (e.g., introduction of biotechnology) that would be outside the experience of local communities. At each scale, the scenarios used could thus incorporate the effects and considerations that might be involved in developing "plausible futures" at both larger and smaller scales.

- The analysis of causal factors and response options will change. Global aggregate information tends to mask the basic patterns of "winners and losers" that are often responsible for the changes being made to ecosystems and largely define the potential response options. (See Figure 3.)

In addition, the nature of the political influence of a multi-scale assessment will be different from that of a single scale assessment. The selection of any scale for an assessment necessarily empowers certain groups at the expense of others by limiting the type of problems that can be addressed and the type of data that are used (MA, 2003). A global scale ecosystem assessment will naturally focus on issues such as climate change, carbon balance and global biodiversity loss, while a more regional or local assessment would give greater weight to issues such as sanitation and access to clean water. A multi-scale assessment can not remove the political bias associated with any assessment but it will result in the aggregate in a more politically neutral assessment process than is the case with a global assessment.

The different scales of assessment within the MA are defined largely by the geographic region of interest and that, in turn, is often defined by the scale at which the intended users of an assessment have decision-making authority. For example, SAfMA defined its largest scale to be the Southern African Development Community (SADC) region, in part because of the presence of a regional policy body (SADC) with an interest in this region. The smallest scales within SAfMA correspond with village and community-level assessments, which again represent institutions with some level of control or governance over the assessment region involved.

Importantly, the actual scale of *analysis* of any of the MA sub-global assessments is not restricted to that region of interest. For example, an assessment of ecosystem change even at

a community scale may require an analysis of global driving forces such as trade patterns or climate change, regional driving forces such as land cover change in upstream areas that have an impact on water availability in the area of interest, and so forth. Moreover, the analysis of response options in a particular local assessment may concentrate on responses within the authority of that local community, but will necessarily also examine possible responses needed at larger scales when such changes would be need to achieve local objectives.

Thus, the MA sub-global assessments might best be seen as a set of different 'windows' into the same interlinked, multiscale, dynamic process of ecological, economic, and social change. Each examines the driving forces, ecosystem changes, changes to human well-being, and potential responses from the standpoint of their relevance in the particular region where the assessment is being conducted. And, each tends to focus on response options that are most relevant to the decision-makers that form their primary audience. Decision-makers at different scales treat some driving forces of change as exogenous (meaning that they have no control over that driving force) and some as endogenous (meaning that their choices can affect the driver) (MA 2003). Thus, a farmer's decisions can have little effect on grain prices while the decisions of a Minister of Agriculture could affect grain prices. On the other hand, a farmer's decisions can directly affect the amount of fertilizer applied to a field. As a result, a user-driven assessment such as the MA will tend to focus most heavily on the decisions confronted by the users at the scale where it is conducted.

Epistemologies within the MA

As noted above, the IPCC has a mechanism enabling the incorporation of non-peer reviewed information within the assessment. It could be argued that the approach adopted by the MA is simply an evolutionary extension of that IPCC-mechanism. While the IPCC was focused on enabling the inclusion of 'gray literature' the MA has only extended the boundaries slightly further to include information obtained through personal communication, so long as that information can be validated through processes developed within the social sciences (see Annex I and Annex II for a description of the procedures approved within the MA).

And in practice, the actual application of this mechanism for incorporating multiple sources of knowledge has been quite limited in the global MA. Even though a mechanism exists to incorporate traditional, indigenous, and practioners' knowledge in the MA global assessment products, in the first draft of the global reports released for review in January 2004 there is little evidence of non-peer reviewed information in the draft reports. It is only at the sub-global scales, and particularly in the community level assessments, where local and indigenous knowledge has been significantly utilized in the MA processes.

In reality, though, the conceptual change implied in this approach is more revolutionary and it poses significant methodological and epistemological challenges that the MA is only beginning to confront.

The norms and procedures of scientific research have evolved and persisted because they have provided a successful mechanism to advance understanding of social and natural systems. Given that background, it makes good sense to ground an assessment of the state of knowledge concerning a particular issue on formal scientific procedures of peer review and publication. Yet as noted above, it is also readily apparent that science is not the only source of knowledge and, in the case of issues concerning the management of ecosystems in particular locales, it may not be the most valuable source of knowledge that can be brought to

bear on a problem. In that context, how could an assessment of the state of knowledge not include local and traditional knowledge?

Faced with this reality, the MA adopted a middle-ground, using the IPCC-like standard of peer review where possible but enabling the incorporation of other forms of knowledge where that knowledge could be validated through the procedures described in Annex I and Annex II. In principle, such an approach can result in better information and better understanding of the issues involved and at the same time can help to confer greater legitimacy on the process among the holders of that local knowledge.

Yet while this approach might be seen as relatively straightforward if the issue is whether or not a paper from a non-peer reviewed conference proceedings should be cited in a global assessment, it is not at all straightforward when the issue involves many other forms of local, indigenous, or practitioner's knowledge. Several challenges are involved:

First, who establishes what is appropriate 'validation' of information? Within the MA, we have adopted a scientific mechanism of validation (triangulation of information, review by other communities, review at other scales, etc.). Yet different people and different cultures use different systems for validating the 'truth' of information. (Indeed, any individual may use different standards themselves for examining the truth of information; the process an individual uses to validate information about whether or not it is raining outside might use different standards from the process of validating information related to religious beliefs.) Thus, while an assessment like the MA might indeed obtain better information through the incorporation of local or indigenous knowledge (because it in essence transforms that knowledge into formal scientific knowledge through an implicit peer review or validation mechanism), do the findings of that assessment in fact have any greater value for the original holders of that information? They may not if the standards by which those communities are judging the truth or legitimacy of information are very different from the standards used by the assessment process.

Second, can an assessment like the MA, which is grounded in a formal western scientific tradition, ever hope to be seen as being "legitimate, credible, and useful" to indigenous communities or other individuals who hold very different world views and use different standards for evaluating the utility of information? For example, to be seen as a legitimate and credible process, the assessment would need to be consistent with norms of evidence and verification accepted by the groups involved.

Within the MA process there is some evidence that this legitimacy and credibility may be possible to establish, although potentially for only a portion of the information provided by the assessment. Two factors seem to be involved. First, certain types of information closely related to basic ecological processes and the management of those processes are, in almost any culture, closely linked to the observed features of those processes. For local communities in the Andes of Peru, for example, information provided by the IPCC concerning climate change, which is consistent with local experience of progressively higher melt of snow-lines on mountains in the region, can be accepted as valuable information, even if the long-term explanations for such changes provided by IPCC might differ from the explanations accepted in those communities. Second, as is common in many sectors, there often exist boundary institutions (or individual 'translators') that can bridge gaps between different world views: institutions or individuals trusted by local communities that are able to also take part in a global process or vice versa.

The actual examples within the MA of attempts to bridge widely different epistemologies within the assessment process will, in the end, be relatively few. And, because these assessments have tended to take longer to get underway than the more 'science driven' processes started in other regions, the lessons that we can obtain from these experiences are only preliminary at this stage. Perhaps one of the most interesting lessons, however has been the experience with attempting to adapt the MA conceptual framework for use by indigenous communities. (See Fig 4.) A conceptual framework for an assessment is, in essence, an agreement among the assessors and users of the assessment of 'how the world works' for the purposes of the assessment. It provides the logical structure for evaluating the system, ensures that essential components of the system are addressed as well as the relationships among those components, gives appropriate weight to the different components, and highlights important assumptions and gaps in understanding (MA, 2003).

The first criteria that the MA Sub-Global Working Group felt that all MA sub-global assessments should meet was that they should all use the same conceptual framework. Yet if there is any one feature of an assessment that is more closely akin to the 'world view' of the system and more likely to create a barrier for the involvement of others who hold a different world view, it would be this conceptual framework. The MA Sub-Global Working Group did identify this problem and agreed that different assessments could seek to adapt the framework in ways more relevant to their needs. The processes now underway to adapt the MA conceptual framework in ways that will work for other world views could prove to be one of the more valuable lessons from this pilot attempt to bridge epistemologies in global assessments.

"Getting it Right" vs. "Making it Relevant"

The MA is a holistic assessment, being conducted at multiple scales, using multiple sources of knowledge. Can something that seeks to be everything in fact provide anything of value to any single user? The MA multi-scale design and multi-epistemology aspirations were established in the belief that the findings of the assessment will be improved through this structure and that, given that the audience that must take decisions on ecosystems are found in all sectors, the findings will be of greater use to the decision-makers that matter. Yet, the institutions we have created in the public and private sector that govern ecosystems and manage them are neither holistic, nor multi-scale, nor multi-epistemological.

This reality sets the stage for a fundamental tension inherent in assessment processes. For an assessment to be most directly relevant to a particular decision-maker it should be highly focused on the specific issue that the decision-maker is dealing with and it should use mechanisms that would be seen by that individual to give it the greatest legitimacy and credibility. Yet, narrowly focused sectoral assessments will inevitably underemphasize important trade-offs with other sectoral concerns and will underemphasize concerns and perspectives relevant at other scales.

Conclusions

The MA is basically an experiment. The two most experimental features, and the two features with the greatest potential value to contribute to future global (and sub-global) assessments are without doubt the multi-scale structure and the MA's attempt to facilitate the incorporation of multiple sources of knowledge in the process. Both of these innovations

pose significant challenges and they will be a major focus of the Assessment Report that will be prepared by the MA Sub-global Assessment Working Group. While on the one hand, the jury is still out as to whether the approach used within the MA will be successful in bridging scales and epistemologies, the experience with the MA to date suggests that, in one way or another, these issues should be addressed in future global and sub-global assessments of the state of knowledge concerning environment and development issues.

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ANNEX I: MA Procedure for Using Non-Published/Non-Peer-Reviewed Sources

(Source: Millennium Ecosystem Assessment. *Procedures for the Preparation, Peer Review, Approval and Publication of Millennium Assessment Reports*; Approved by MA Board on January 16, 2002; Revised May 16, 2002 and September 28, 2002. Available at: http://www.millenniumassessment.org/en/products.aspx)

Because considerable materials relevant to MA Reports, in particular, information based on indigenous, traditional, or local knowledge or information about the experience and practice of the private sector, are found in sources that have not been published or peer-reviewed (e.g., industry journals, internal organizational publications, non-peer reviewed reports or working papers of research institutions, proceedings of workshops, personal communication, etc.) the following additional procedures are provided. These have been designed to make all references used in MA Reports easily accessible and to ensure that the MA process remains open and transparent.

1. Responsibilities of Coordinating, Lead and Contributing Authors

Authors who wish to include information from a non-published/non-peer-reviewed source are requested to:

a. Critically assess any source that they wish to include. This option may be used for instance to obtain case study materials from private sector sources for assessment of adaptation and mitigation options. Each chapter team should review the quality and validity of each source before incorporating results from the source into an MA Report.

b. Send the following materials to the Working Group Co-Chairs who are coordinating the Report:
   - One copy of each unpublished source to be used in the MA Report
   - The following information for each source:
     - Title
     - Author(s)
     - Name of journal or other publication in which it appears, if applicable
     - Information on the availability of underlying data to the public
     - English-language executive summary or abstract, if the source is written in a non-English language
     - Names and contact information for 1-2 people who can be contacted for more information about the source.

c. Information based on personal communication from individuals with indigenous, traditional, or local knowledge, or direct input as a member of a working group by an individual with indigenous, traditional, or local knowledge should be handled in the following way:

   i. In situations such as local assessments where extensive use of local and traditional knowledge will be involved, the assessment must establish a process of validation for the findings as part of the application by the assessment to become a component of the MA. The features of such a validation process are described in Section 0. [See Annex II.]

   ii. Metadata concerning the personal communication (e.g., names of people interviewed, dates and types of notes recorded, presence or absence of self-

critical review notes by the researcher, sources of 'triangulation', etc.) should be made available to the Co-Chairs of the Working Group.

iii. Where an individual provides direct input of indigenous, traditional, or local knowledge as a member of a working group, the individual should provide the Working Group Co-Chairs coordinating the report the following information:
   - Basis for knowledge of the particular issue (length of time living in the area, individuals from whom historical information was obtained, etc.)
   - Names and contact information for 1-2 people who can be contacted for more information about the source.

2. Responsibilities of the Review Editors
The Review Editors will ensure that these sources are selected and used in a consistent manner across the Report.

3. Responsibilities of the Working Group Co-Chairs
The Working Group Co-Chairs coordinating the Report will (a) collect and index the sources received from authors, as well as the accompanying information received about each source and (b) send copies of unpublished sources to reviewers who request them during the review process.

4. Responsibilities of the MA Secretariat
The MA Secretariat will (a) store the complete sets of indexed, non-published sources for each MA Report not prepared by a working group and (b) send copies of non-published sources to reviewers who request them.

5. Treatment in MA Reports
Non-peer-reviewed sources will be listed in the reference sections of MA Reports. These will be integrated with references for the peer-reviewed sources. These will be integrated with references to the peer reviewed sources stating how the material can be accessed, but will be followed by a statement that they are not published.

Annex II: Sub-Global Assessment Peer Review

(Source: Millennium Ecosystem Assessment. *Procedures for the Preparation, Peer Review, Approval and Publication of Millennium Assessment Reports*; Approved by MA Board on January 16, 2002; Revised May 16, 2002 and September 28, 2002. Available at: http://www.millenniumassessment.org/en/products.aspx)

Section 5.6.3. Sub-global assessments may develop review processes tailored to the circumstances of the assessment and the scale at which it is undertaken. Each sub-global assessment must provide a description of its review process to the MA Panel and Board at the time of its approval.

Sub-global assessment review processes must meet the following criteria:

a. The review process must be independent. An independent party not involved in the governance or operations of the sub-global assessment must have the authority to determine whether reviewer inputs have been sufficient, and whether the comments have been adequately handled;

b. Relevant governments (for the scale at which the assessment is conducted), NGOs, regional institutions and other organizations as appropriate must be contacted in advance to identify appropriate reviewers, and reviews should be requested from all these sectors;

c. Reviews should be requested with the aim of obtaining a balanced representation of views within the region involved, and among scientific, technical and socioeconomic perspectives;

d. Reviewers should include experts involved in the larger and smaller scale assessments within which the assessment is nested, or that are nested within the assessment;

e. All written review comments, and the responses to those comments, should be provided in their original language to the MA Secretariat, where they will be kept on file.

Within the framework of these criteria, the sub-global assessments are encouraged to design peer review processes relevant to the circumstances of the Assessments. Each sub-global assessment will need to prepare a description of the peer review process that it will use and this must be approved as part of the approval process for accepting the Sub-Global Assessment as a component of the MA. Sub-global Assessments can establish peer review processes that do not meet all of the above criteria. To do so the description of the proposed peer review process submitted to the MA Board should note where specific peer review criteria are not met; the MA Board can then approve the peer review process and establish the language that will be used in the description of the final reports (e.g., the inclusion of a footnote explaining how the peer review process used for the report differs from the standard MA peer review process.)

Local or Community-based assessments generally will include significant amounts of information gathered from individuals, and based on local, traditional and/or indigenous knowledge. These assessments should meet the review process criteria described above. In addition, they should also establish a process for "validating" information obtained through interviews, or based on such knowledge, as part of the application by the assessment to become a component of the MA.

Typically, the validation process should include many, if not all, of the following features:

a. Self-critical review notes or reflective diaries: the researcher should record information on his or her own perceptions of where information being recorded may be incomplete, biased or in error;

b. Triangulation: multiple sources of information should be obtained, particularly for critical pieces of information;

c. Review by communities: members of the community should be given an opportunity to review the findings prior to finalization of the assessment;

d. Review by stakeholders at higher and lower scales: individuals who may not have detailed local knowledge of the area being assessed, but with knowledge of the region in which the assessment is located, should be given an opportunity to review the findings prior to finalization of the assessment.

For the MA working group assessment reports (including the synthesis report of the Sub-Global Working Group), additional requirements exist for the use of information based on personal communication from individuals with local/traditional/indigenous knowledge, or direct input from working group members with such knowledge.

a. Metadata concerning the personal communication (e.g. names of people interviewed, dates and types of notes recorded, presence or absence of self-critical review notes by the researcher, sources of triangulation, etc.) should be made available to the Co-Chairs of the working group;

b. Where a working group member provides direct input of local/traditional/indigenous knowledge, the working group Co-Chairs should be given the following information:

c. Basis for knowledge of the particular issues (e.g. length of time living in the area, individuals from whom historical information was obtained, etc.);

d. Names and contact information for 1-2 persons who can be contacted for more information about the source.

Figure 1. Millennium Ecosystem Assessment Conceptual Framework. (Source: MA, 2003)

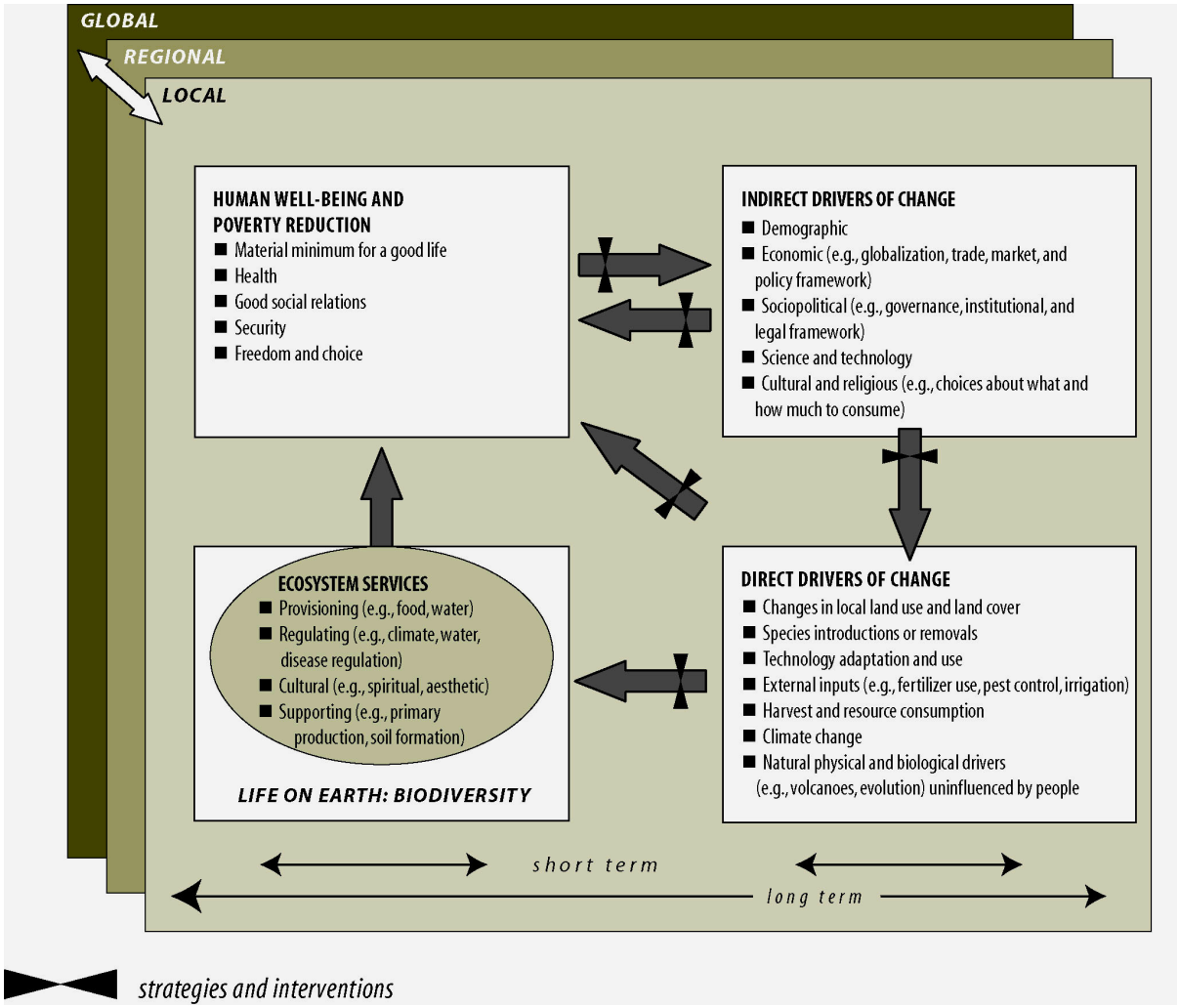

Figure 2. The three geographic scales of the Southern Africa Millennium Ecosystem Assessment (Source: Scholes, R., and O. Biggs. Unpublished manuscript. Ecosystem Services in Southern Africa: A Regional Assessment.)

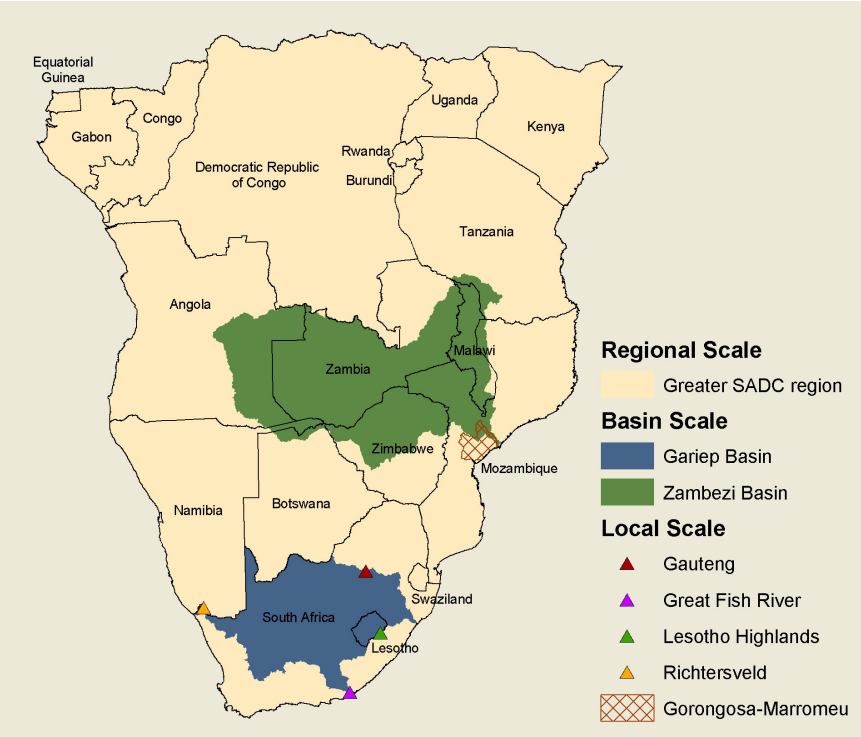

Figure 3: Effects of Geographic/Economic Scale on Net Gain (Benefits minus costs) arisi from effects of climate change on society and the role adaptation might play in mitigating t more negative outcomes. (From: Canadian Global Climate Change Study, cited in Wilbanks, T.J., "Scaling Issues in Integrated Assessments of Climate Change." Matrix 20 Workshop on Scaling Issues in Integrated Assessment, International Centre for Integrative Studies, Limburg Netherlands, July 2000.)

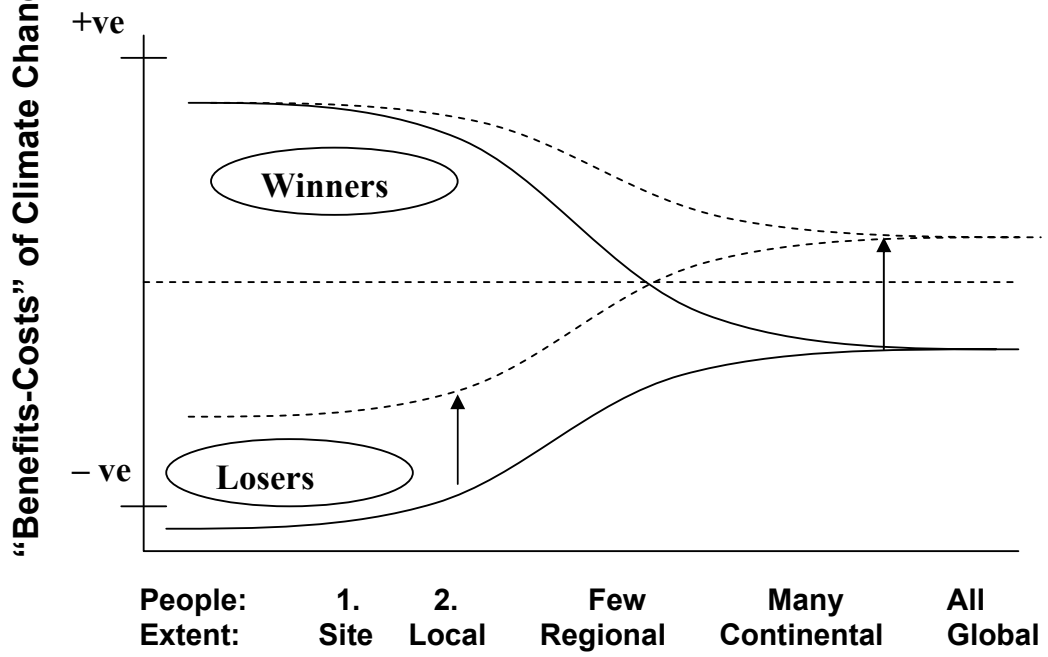

Figure 4. Adapting the MA Conceptual Framework to Local and Indigenous Conceptual Frameworks of Ecosystems and People