# Eye on Earth Summit

Working Group 2 – Content and User Needs

# White Paper

DRAFT
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| Document Revision Log | | | |
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# 1.0 Introduction

## 1.1 Background and Purpose

The Eye On Earth Summit - Abu Dhabi 2011 ("The Summit") is a global intergovernmental and multi-stakeholder event and exhibition to convene the thought and action leaders in the worldwide environmental and societal information networking movement, to converge consensus on key areas of mutual importance, and to collaborate towards strengthening existing initiatives and filling gaps towards more informed policy making and a sustainable future. The Summit is expected to:

a) Identify commonalities in existing environmental information networks in an effort to strengthen, align and synergize these initiatives while collectively filling the gaps through coordinated alignment of common efforts;

b) Strengthen, synergize, and extend global processes for bridging the environmental knowledge gap and provide data, information and tools for decision-making (transformative action);

c) Reinforce multilateral policies and institutional arrangements to leverage investments in environmental data while ensuring the preservation of the investment in this information to improve information infrastructure in countries needed to support more coordinated, effective and sustainable development;

d) Support technical cooperation to accelerate the building of a federated global environmental information infrastructure;

e) Accelerate capacity building and technology support programs around the world to further close the gap between developed and developing nations.

f) Strengthen access to resources to support developing countries

This document presents a set of topical issues that are the initial outcomes of each Working Group based on collaborative research and evaluation by its members. This Thought Paper provides Issue Statements based on an identification of issues, the current situation regarding each issue, major stakeholders engaged in addressing these issues, opportunities and constraints, and the major impacts and outcomes that can be achieved by further addressing the identified issues as part of the Summit. The identified topical issues will be submitted to the Framework Committee for review that will lead to the selection of a subset of topics that the Working Groups will then focus on more intensively. Based on the selected topics, the Working Groups will expand each Issue Statement into a more detailed White Paper. During its second meeting, the Framework Committee will review the White Papers and use them as the basis for the development of the Summit program and special initiatives.

## 1.2 Process and Results

The planning, design and development of the Summit involves a very diverse range of issues and a large number of simultaneously moving parts. The Working Group and Framework Committee efforts, with the feedback from the Executive Advisory Board will in large part define the Summit content and special initiatives that will be the visible output of the Summit preparation process, and that will define the path forward for some years to come. In general, the process for defining the Working Group white papers includes the following:

Identification of Topical Issues. Working Groups will assess previous topical issues submitted by the stakeholder community and identify a set of topical issues they would like to address as part of their initial evaluation.

Develop Thought Papers. For the identified issues, a Thought Paper will be developed that elaborates each issue by illustrating the importance, implications, major stakeholders, potential impact and special initiatives that could be generated.

Framework Committee Review and Approval. The Thought Papers will be reviewed by the FC, which will recommend specific topical issues to be further developed into a more refined White Paper.

White Paper Development. White Paper development will treat each selected subject in more detail and will include the direct participation and buy-in of key affected stakeholders.

Final Nomination and Commitments. The Framework Committee will evaluate the White Papers and use the submitted information to develop the Summit program and to recommend if any White Papers should be featured as Special Initiatives to be announced during the Summit closing.

## 1.3 Working Group Definition and Purpose

Working Groups will be responsible for:

- identifying key issues in their topical area of focus;
- suggesting speakers and panellists that might be recruited to address these issues;
- identification of programs within each topical area that might be aligned and coordinated among multiple programs for mutual benefit;
- propose initiatives that can be considered candidates for featuring in the 4-6 Special Initiative Outcomes to be formulated through the Summit process and announced at the event.

## 1.4 References

This report includes provisions that are more fully described in other documents and that are included by reference, including:

***Eye on Earth Summit Program Design.*** Original Program Design dated 1 May, 2010. This document is being updated as part of the Summit detailed planning stage. Its provisions will have influence on the detailed activities of the GPC Team.

***Executive Advisory Board, Framework Committee and Working Groups Charter.*** This document provides the Charter for each of these Groups describing their purposes, processes, intended outputs and interdependencies.

***EoE Special Initiatives***. A critical objective of the Eye on Earth Summit is to ensure that there are compelling, specific, achievable outcomes that translate the principles of the Summit to "on the ground" commitments and actions. A target of 4-6 EoE Special Initiatives has been set, each of which is to be defined through the Summit preparation process, and announced during the Closing Plenary.

***WG Thought Papers.*** As an initial input, the Working Groups each developed a Thought Paper that identified and articulated the initial set of issues and special initiatives each WG considered to be the important issues for which content should be developed around for presentation at the Summit and/or Exhibition. The Thought Papers become the starting point for the White Papers by further articulating and expanding on the notions originally presented such that the White Paper can be used to guide and develop the Summit Program.

***FC Feedback on WG Thought Papers***. This report synthesizes the Framework Committee's feedback to the Working Groups on the submitted Thought Papers. This synthesis is based on the a review of the Thought Papers and Special Initiatives as part of the Framework Committee meeting that was held in Geneva, Switzerland on 27-18 July 2011.

# 2.0 Content and User Needs

## 2.1 Executive Summary

The importance of sharing Environmental Information (EI) has been identified by a number of Summit declarations and Agendas over the last 20 years. It is only in the last decade, however, that technology, governance, information and capacity are converging to enable the effective sharing of Environmental Information.

In order to facilitate this convergence, from a Content and User Needs perspective, there are a number of key principles that need to be kept in mind. These key principles include:

- A need for relevant, high quality EI.
- The existence of environmental challenges from a global scale through local scale, and in the future, these challenges will become more complex in nature.
- The consequence of inaction around EI is that, inevitably, management responses will fail.
- The need to find the 'right' information, and to use it to address the challenges that emerge.
- Environmental Information Systems (EISs) should deliver specific types of functionality.
- An effective EIS needs to be a fluid, organic ecosystem of data and information.
- All levels of societal organisation need to be acknowledged and encouraged to contribute to multiple roles in the EIS in a simultaneous manner.
- The most appropriate tools should be used to facilitate inter-personal communication.
- Data providers need to communicate with Users and acknowledge that the conceptual framework of each user is unique and is related to a specific task and its achievement.
- Everyone in the world can be an Actor in an EIS.

In order to highlight the challenges surrounding Content and User Needs, nine issues were identified and discussed in depth. These challenges include:

1. The creation of incentives for uniting stakeholders in processes, which reflect the organic and systemic nature of environmental information.
2. Addressing the difficulty of simplifying large datasets to assist with decision-making.
3. The building of mixed models of old, new and emerging technologies such as ground stations, sensor webs, satellites, crowd sourcing and data mining.
4. The need to communicate creatively through using multiple user-friendly formats, common delivery vehicles and multiple languages.

5. The need to address critical capacity requirements as they directly impact on content and user needs.
6. Characterization of the state, trends and outlooks of the environment.
7. The need to support environmental governance.
8. The need to integrate environmental and socio-economic data.
9. The need to empower people through open access to environmental information.
10. Provision of effective global surveillance and early warning systems.

Key recommendations for "quick wins" emerging from this White Paper are:

- A need to digitise legacy data and link indigenous people's perspectives into visualization techniques and products.
- The capture and integration of culturally traditional knowledge with crowd sourced data in order to deliver a 'real world' impact.
- Governments should institute legislation formalising the human right of access to information.
- All organisations should undertake major focused data collection exercises.

## 2.2 Laying the Foundation of the White Paper

### 2.2.1 Introduction

Humanity is currently facing a range of significant environmental challenges such as global warming, species extinction, pollution, food scarcity and overpopulation. Environmental Information tools and Informatics techniques help facilitate responses to these challenges, and assist with planning for future environmental issues. The Information content of these tools is vital in order to drive the techniques needed for the management of a sustainable environment. The information content is used in a variety of ways including evidence based policy, environmental monitoring through identified environmental indicators, trend analysis and modelling and post adverse event assessment.

As the "Environment" increases its position on local, national, international and regional agendas, the need for relevant environmental information also increases. This increased need for this type of information, coupled with the ever increasing volume of information being generated and disseminated via constantly developing and improving media is allowing broader sections of society the 'voice' in the "Environmental Debate".

This White Paper highlights some key issues in fuelling the information needs of all stakeholders and looks at some future issues which might assist in improving the content of Environmental

Information to further meet the needs of users. Before addressing the issues, it is important to have an understanding of the history and context of the use of Environmental Information.

### 2.2.2 History

*Environmental Information Practice*

Before discussing the history of environmental information, it is important to understand the bounds with which we will be discussing this information. Haklay (2001) made 6 assertions underlying Environmental Information practice:

Sound knowledge, reliable information and accurate data are vital for good environmental decision making.

Within the framework of sustainable development, all stakeholders should take part in the decision making processes. A direct result of this is a call for improved public participation in environmental decision making.

Environmental information is exceptionally well suited to GIS (and vice versa). GIS development is closely related to developments in environmental research, and GIS output is considered to be highly advantageous in understanding and interpreting environmental data.

To achieve public participation in environmental decision making, the public must gain access to environmental information, data and knowledge.

GIS use and output is essential for good environmental decision making.

Public Environmental Information Systems should be based on GIS technologies. Such systems are vital for public participation in environmental decision making.

This is a very “Geospatial” centric view; however it does summarise the broader principles of Environmental Information and its use.

*Environmental Revolution*

Environmental Information has been used in various guises over millennia; however it was the 1960s that marked a clear turning point in attitude towards the environment and heralded the “environmental revolution” (McCormick, 1995). In the late 1960s the USA introduced the landmark “National Environment Policy Act – NEPA (1969), one of the first environmental policy legislations directly addressing Environmental Information vehicles such as state of environment reporting and environmental impact assessments. At about the same time the UK created the Royal Commission on Environmental Pollution, which led to the formation of the Department of the Environment in 1970. Both these bodies were formed as a result of public pressure (McCormick, 1995). This was followed in 1973 by the formation of the European Community Environmental Programme (Briggs, 1986).

The next major step in the “mainstreaming” of Environmental Information followed the United Nations conference on "The Human Environment" held in Stockholm in June 1972, with the formation of the United Nations Environmental programme. One of the key urgent tasks for the new UNEP was to collect data and information about the environment (Wallen 1997). By 1977, the European Commission’s (EC) second action plan, environmental information was a focus area, together with Environmental Impact Assessments (EIA’s) (Briggs, 1986). Towards the end of the 1970s the Global Environmental Monitoring System Unit of UNEP created INFOTTERA, a focal point providing the service for locating environmental information through computerised queries (UNEP, 1979).

*Rio 1992 and Beyond*

The importance of Environmental Information has been highlighted in a number of defining Environmental events or documents. At the **Rio "Earth Summit"** in 1992 Principal 10 in the Summit Declaration stated that:

"Environmental issues are best handled with participation of all concerned citizens, at the relevant level. At the national level, each individual shall have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their communities, and the opportunity to participate in decision making processes. States shall facilitate and encourage public awareness and participation by making information widely available. Effective access to judicial and administrative proceedings, including redress and remedy, shall be provided" (UN, 1992a).

In addition to the declaration from the Summit in Rio, the **Agenda 21** plan of action was formulated. Environmental Information is more specific with its addressing of Environmental Information, strengthens the role of major groups and recognises the need for public access to environmental information. It mentions a section in each chapter dealing with Environmental Information as well as a whole chapter (chapter 40) dedicated to "Information and Decision Making" (UN, 1992b).

During the 1990s, public access to environmental information was targeted together with the building of information systems to serve environmental information to the public (Haklay, 2001). In 1998, the first pillar of the **Aarhus Convention 1998** (UN/ECE, 1998) stated that: "Access to information: any citizen should have the right to get a wide and easy access to environmental information. Public authorities must provide all the information required and collect and disseminate them and in a timely and transparent manner. They can refuse to do it just under particular situations".

In 2002, **Johannesburg "World Summit on Sustainable Development"** identified the importance of information in position 1 of the declaration "Whatever one's citizenship, place of residence, age, sex, race, nationality, religious, political and civic convictions, social and economic status, everyone must have an inherent right to a healthy and fruitful life in safe and comfortable conditions, access to complete and reliable environmental information, participation in discussion, development and taking decisions that can effect his/her life and the life of future generations.

Over 40 points on Information are included the Implementation Plan points, examples include (UN, 2002):

Point 6 (Poverty Eradication), Clause (l) states: "Combat desertification and mitigate the effects of drought and floods through such measures as improved use of climate and weather information and forecasts, early warning systems, land and natural resource management, agricultural practices and ecosystem conservation in order to reverse current trends and minimize degradation

of land and water resources, including through the provision of adequate and predictable financial resources to implement the United Nations Convention to combat desertification in those countries experiencing serious drought and/or desertification, particularly in Africa, as one of the tools for poverty eradication".

Point 14 (Changing unsustainable patterns of consumption and production), Clause (e) states: "Develop and adopt, where appropriate, on a voluntary basis, effective, transparent, verifiable, non-misleading and non-discriminatory consumer information tools to provide information relating to sustainable consumption and production, including human health and safety aspects. These tools should not be used as disguised trade barriers".

Point 15 (Changing unsustainable patterns of consumption and production), Clause (c) and (d) respectively states: "Collect and disseminate information on cost-effective examples in cleaner production, eco-efficiency and environmental management, and promote the exchange of best practices and know-how on environmentally sound technologies between public and private institutions;" and "Provide training programmes to small and medium-sized enterprises on the use of information and communication technologies".

Point 24 (Protecting and managing the natural resource base of economic and social development), Clause (b) states: "Facilitate access to public information and participation, including by women, at all levels, in support of policy and decision-making related to water resources management and project implementation".

Point 25 (Protecting and managing the natural resource base of economic and social development), Clause (b) states: "Employ the full range of policy instruments, including regulation, monitoring, voluntary measures, market and information-based tools, land-use management and cost recovery of water services, without cost recovery objectives becoming a barrier to access safe water by poor people, and adopt an integrated water basin approach".

Point 45 (Sustainable development in a Globalizing World), states: "Assist developing countries and countries with economies in transition in narrowing the digital divide, creating digital opportunities and harnessing the potential of information and communication technologies for development, through technology transfer on mutually agreed terms and the provision of financial and technical support, and in this context support the World Summit on the Information Society."

Other points regarding Information appear throughout the Implementation Plan.

What these summits and conventions have indicated is that there has been a robust understanding of Information as it relates to the environment for at least 20 years. Over this period, most environmental information, both paper based and digital, paid little attention to the needs and requirements of a broad range of users, but focused on the technical and scientific user (Haklay, 2003). The Rio Declaration, June 1992 and Agenda 21 link public access to information to the principle of sustainable development, stressing the importance of including all stakeholders in the access to and decision making from environmental information. In order to achieve this there

would need to be a change in emphasis or at least an increase in the availability of interpreted information. It is really only in the last 10 years, with the advent of social networking and crowd sourcing, facilitated by technologies such as Web 2.0 that society has been able to interact with environmental information and participate, to some degree, in environmental decision making. It is clear that profound changes have taken place between the 1960s, 1970s and early 2000s. The prediction that the challenges of environmental politics and the provision of improved public access to environmental information would become key issues have come to fruition and still remain a challenge today. Public participation became the main focus post 2005.

Through various user needs and content issues, this White Paper intends to highlight key principle which are fundamental in addressing the future directions of Environmental Information Systems, from a user needs and content perspective:

### 2.2.3 We need good environmental information

The need for good management of scarce and valuable resources is well understood, and good information makes it easier to take good decisions.

We already face environmental challenges, at global and more local scales, and in the future they will become more complex.

These megatrends include climate change, salination, acidification, resource depletion and an increase in natural disasters. As science and society increase in complexity, the number of moving pieces in each of these challenges has increased. Managing the increased number of variables needs to be considered when formulating decisions.

The consequence of inaction around environmental information is that our management responses will fail.

We want to find the right information, and to use it to address the challenges

We want to find answers to questions, rather than only finding data. This requires an ability to distinguish between appropriate and inappropriate uses for data, and to share those judgments with others.

A good EIS should deliver specific types of function

It should help with collecting data/information, managing it, and communicating/disseminating it. Within different timescales and contexts, each will be relevant to every user.

We need a fluid, organic ecosystem of data and information

Designing an all-encompassing global system is neither desirable nor feasible. Instead, the focus should be on investing in conditions and tools to allow the system to function.

We should acknowledge and encourage people to play multiple roles simultaneously

By-products of activity can be highly valuable to others, and we can facilitate the better discovery and use of them. These involve different scales and themes.

The multiple roles may include consumers, producers, editors, manipulators, integrators, aggregators, evaluators and networkers.

We should collect and use only the required number of datasets in order to address the challenge

Bringing too much information to a problem can be as constricting as data scarcity, and more distracting.

We should use the best tools to facilitate personal interactions

A good system uses people and technology for what they are each best at. An EIS is not solely a technological solution. The tools include options as varied as cloud computing, crowd sourcing, mobile technology, paper and pen, and story-telling.

Everyone in the world can be an actor in the system

Technology allows the user base for environmental information to be global. The actors in the system are therefore diverse, and they interact with each other differently at different times for different purposes. People learn or use information in different ways, so information must be available in multiple formats, for multiple uses.

## 2.3 Issues Facing User Needs and the Content of EIS

### 2.3.1 Create Incentives Among Individuals and Institutions to Encourage Sharing of Information and Data through Organic Networks

*Setting the Foundation*

A Transitional Information Ecosystem – "EIS 2.0"

Information exchange for sustainable development, as in most aspects of societal engagement, is well represented at its various levels, such as movement across several trophic levels of an ecosystem. We can describe information moving from the individual to an institutional context at the local, national, and global level. The motivations and interactions actually remain similar at each level, but the nature of the information is subject to change. Information can be considered as a resource whose transfer is motivated by an increase in well-being to the originator based upon the demands of its recipient. All human organization seeks to maintain or increase its well-being, whether at an individual level or at some higher level of organization. Both seek resources and security for their survival, whether an individual seeking food and sustenance, a firm seeking to maintain market-share, or a government seeking to maintain its economy and secure its borders. The primary incentive to share information remains solidly within an individual's or institution's self-interest. The challenge, therefore, is to create incentives that provide some pay-off that is in the

interest of the information-sharing entity. The objective is to balance both sides of the relationship in the short-term.

Through this emerging distributed network of information exchange, along with the growth in technology and scientific expertise, vast amounts of information is now available to decision-makers. A second challenge is to harness this flow to improve decision-making itself, whether it takes place in a farmer's orchard, a mangrove swamp, or the halls of government. The next generation of environmental information systems must meet user needs. They must be accessible and selected from the deluge of information in the global network. They must also be available in a useable format and within the decision-maker's timeframe.

These requirements call for increased technical and scientific capacity, but also for an awareness of the importance of science in the decision-making process. This awareness and acceptance is equally important within the scientific community as at the level of the decision or policy-maker. Essentially, incentives are as important for users of information as generators of information. This is an organic whole and the boundaries are not well-defined, nor should they be.

What is required is an organic system that mirrors an ecosystem where actors play multiple roles, both as users of information and generators of information. Data comprise elements of the flow. This stream is acted upon by individuals and institutions, transforming it into information, which in fact, may be viewed as data farther downstream. All actors then define their needs in their own context, which provides the impetus for the system to organize, evolve, and grow.

The recent past: Hierarchy and zero-sum

Traditionally, the flow of information follows the customary hierarchical nature of human organization. It is also locally centralized. In such a case, information that flows through individuals who were spatially or socially close and tended to follow the hierarchical lines present, whether it be through an organizational structure of a corporation or government, or whether it was through the social structure that may be described by a clan or village.

The present: A phased transition

Currently, we are seeing a transition from this hierarchical structure to a more widely distributed structure. This has been driven by a number of factors, but specifically major trends from population growth, urbanization and major migrations; processes of globalization; and of foremost importance, technology. Traditional hierarchical structures are changing and individual ties to these structures are weakening. The localized nature of these ties in which information is shared with those who are physically close is also changing. This process of change is not uniform throughout the world or even throughout a particular country.

The nature of information is changing as well. Previously, information was either held in one's head or in some physical (paper) format. As such, it was largely seen as a private good, which was rivalrous in that its costs were potentially high to the individual as it was shared; and was

exclusive in that the individual could limit access to information. Science thrives on openness. Papers that go unread might as well never have been written. Yet the scientific publishing industry seems to believe the exact opposite, charging outrageous fees to anyone not affiliated with an institution who wishes to read a paper. Per-paper fees of 30 to 40 dollars are the norm. University libraries and other institutions are forced to subscribe to essential journals despite prices that can easily exceed 20,000 dollars per year per journal. They are cutting back on book-buying to make ends meet. And scientists in less-developed countries? They might as well forget following their field, or emigrate if they want to work.

It's a nice business to be in: the gross profit margins of publishers like Elsevier exceed 40%. No surprises there: no-one who does the hard work - researching and writing the paper, peer-reviewing it, editing it - gets paid. It's all done by scientists operating on the honour system.

For the world, however, this is a catastrophe. Scientific information is inaccessible to many thousands of those who could make use of it. Ideas cannot be properly discussed; experiments cannot be replicated; and progress slows down.

This, too, is a major issue to us who are concerned with access to data. We should consider what we, as a Working Group, can recommend to break the monopolistic behaviour of the science publishing houses and free research for the benefit of all. These characteristics are changing, with the most dramatic change being largely driven by technology such that information is becoming less rivalrous. Meaning the cost to the entity sharing information is dramatically reduced. This can be visualized by the growth of electronic media. Documents can be widely shared among millions of individuals by any individual by e-mail, websites, CD/DVD, or thumb drives. Even exclusivity of data is becoming less concrete as browsers and data mining software can extract broad personal and previously closely held data by anyone with the appropriate know-how and (importantly) access to the Internet.

*Issues, Challenges and Opportunities*

Opportunities

This issue is well positioned to improve information and data management initiatives at all scales, especially those which rely on aggregation of data sourced by partners at national or site level. This links to a key principle of building upon existing capacity and embracing local initiatives versus using a top-down or imposed approach.

This complements both the User Requirements Register (URR) proposal and the User Engagement ideas. While the URR looks at what users *want*, this proposal concentrates on what users *need* in order to maintain their participation and contributions.

Challenges

The reputational aspects require widespread change in approach at many levels, especially at the global level. This is necessary in order to explain the value of what is done by the data collectors at

different levels, so as to motivate continued contribution without the need for continual relationship management.

The tools to manage information need to be more straightforward and focus on the challenges faced by the user interface experience. The technical infrastructure used to link users together is technically new, but based on existing networks and technology.

*Direction and Way Forward*

The future: Networks transcend geography

The not too distant future presents a level of social organization and accompanying information flow that will be more widely distributed. Connections will be more diffused and decentralized as a cluster network versus a hierarchy. Information will increasingly exhibit attributes of a public good: non-rival and non-exclusive. Due to advancements in electronic media and telecommunications, information will be shared more based on personal and institutional connections as a social network in which physical proximity will be less important. In an extreme case, individual privacy and state secrets will no longer exist in practical terms, as is demonstrated by phishing scams and government documents leaked to the Internet. The important challenge is not only how to manage this process, but how individuals and institutions can position themselves to remain relevant in this process and how to use this new social structure to increase their influence, which is the ultimate incentive to engage in this organic system.

Incentives make the system function

In the search for current, comprehensive environmental information and data about the world, there is more collected than we currently have ready access to. The challenge of making the global information and data on environment available and accessible to the greatest number of people can be viewed as a problem of incentive. At this small scale, the challenge is to provide incentives to encourage people to contribute and maintain the information and data[1] they have, and to locate information that they need but don't have.

The motivations and incentives for individual people to participate are currently not fully incorporated into the design of systems needed to collect and distribute information. A reliance on institutional mandates and a general expectation of altruistic contribution are not proving to be effective mechanisms to drive a rich network of sharing. A more active and deliberate approach to providing the incentives for individuals to share what they have is necessary if we are to make best use of the resources already being invested in environmental management across the world.

Participation costs

[1] Although information and data are different, for brevity, the rest of the paper uses 'information' to refer to both.

There are always costs incurred in sharing information: taking time to consider whether to share or not; data management costs to clean and fix data; hosting, storage, transmission; reputational and security risks. Technology can play a large role in reducing many of these costs, but human input is vital for the system to function: these human costs are harder to reduce with technology, and can remain a significant limiting factor.

An effective system for sharing environmental information across the world at different scales needs to use technology for what technology is good at, and rely on people for what people are good at. Technology can help us shift large amounts of information great distances, or share small amounts of information with many different users, at very low cost. The agreement to move that information almost always depends upon relationships between people.

Participation should also reward

Institutional mandates are critical mega-scale components that underpin the largest scale of cooperation, but these mandates alone are not currently driving effective cooperation. Generally, incentives should increase the well being of the individual or institution.

For individuals, profile and reputation may the most important options to explore. In addition, the provision of tools for carrying out one task, for example, to make the handling of information and data easier, can be designed to generate by-products which can also be captured, for example, meta-data on datasets being handled.

These incentives should cover both individual and institutional scales. At individual level, incentives need be apparent to the individual in a short time-frame relative to the transaction. Any sharing transaction needs to satisfy both parties. Benefits relating to institutional mandates may take far longer to materialize, while and individual is more likely to work on shorter time-frames.

These combine to produce a situation where the individual directly benefits, and in so doing, contributes to a wider societal benefit. This can be very effective if it involves capturing of by-products from individual level activities. There are clear examples of this see box below.

Incentives to engage in multiple ways

The individuals in the system can simultaneously play multiple roles, which represent multiple possible entry-points to stimulate engagement.

*Examples*

- UNEP-WCMC protected areas data. The "Protected Planet" database is a first step towards identifying protected areas around the globe. There is a proposal to nationalize the programme so as to give individual countries a space and tools to manage, and benefit from their own data, which ultimately contributes to the global dataset.
- Another working example of this approach comes in the form of a communal nature conservation area monitoring programme running in Namibia, known as the "Event Book". The community decides what information is useful to them (with the inclusion of a few core fields). They keep their own data, but regularly pass on a copy of the aggregated observations to the coordinating organisation.
- Google's model for email provision is similar: a user has access to useful tools to manage their own data, and in return they have access to the resource – the users entire email archive. Key here is that they access an anonymous, aggregated version of the data, which from the user's point of view is a by-product of using the system and requires no effort from the user, compared to the effort of filling out questionnaires in order to provide the same information.
- Android traffic updates – consumers of traffic information are also producers. The by-product of the consumption of traffic data contributes directly to traffic data, which benefits all users. Key here is that by contributing data to the system makes no additional demands on the user.

*Conclusion*

With this proposed new take on EIS, things can be done differently. Examples that could provide benefits include; building capacity and empowering people at all levels, as well as, improving the decision-making process. Both of which underpin better sustainable development.

*Crosscutting issues*

There is a need for infrastructure to support the sharing of environmental knowledge, data and information. In addition to this, there is a need for a global environmental knowledge network. Infrastructural support hinges on solid governance and policy frameworks for ensuring that all user groups make collected information available for general use. These issues are fitting with WG3 - Technical Infrastructure.

### 2.3.2 Build mixed models of old, new and emerging technologies: ground stations, sensor webs, satellites, cloud computing, crowd sourcing, data mining and citizen science

*Taking advantage of open data initiatives*

Infrastructure and technology for monitoring, modelling and reporting of assessments and analysis has improved significantly in recent times, and is directed increasingly towards web presence and data availability an example of an open data initiative the US government's Data.gov (http://www.data.gov/). A global environmental information system should and needs to respond to demands from the new wave of technological society and ensure it meets the current and future demands and technical directions of the communities it serves.

Compared to other sectors, the environmental sector is not taking advantage of the technological advancements and opportunities available in order to improve the provision and sharing of timely, quality assured data and information for assessing the state and outlook of the environment from local to global levels.

New technological advancements and standards have broadened the stakeholder reach to the global, regional, international, national as well as local levels, catering for the widest possible range of society and addressing the current and future needs of decision makers, scientists, students, farmers, including members of civil society with limited access to and knowledge of computers and technology. Social media are starting to contribute to bridging the gap between all users and information providers.

It is important to secure the long-term sustainability of previous investments in environmental information and integrate them with new emerging technologies and methodologies such as sensor web, new space infrastructure, crowd sourcing, local and traditional knowledge sources.

Adapting and conforming to new technologies that guarantee to keep environmental information current and widely available at a reduced cost will ensure an open, online access to a wider sector of society at any point in time and space. It is important for the process of environmental systems creation not to be fully technology driven so as to ensure a realistic response to community user needs.

*How to address this issue - Stakeholders*

The most important stakeholders in dealing with this issue are:

- Governments and specialised agencies with an observing, monitoring and reporting role, e.g. GEO (Group on Earth Observations), WMO, WHO, Environmental Agencies etc.
- The Information and Communications Technology (ICT) sector responsible for handling all relevant data, infrastructure application and development, e.g. ESRI, Microsoft and Google amongst others.
- Non-Governmental Organisations, e.g. Bird life international, Red Cross, Conservation International and the World Wildlife Fund, etc.
- United Nations and international agencies such as UNEP, IUCN, UNFCCC, FAO, UNESCO and UNDP.

- Added value industries, e.g. EARSC (European Association of Remote Sensing Companies), MEMS Industry Group for sensor development, etc.
- Academia and research entities supporting research and environmental modelling and analysis role, e.g. Intergovernmental Panel on Climate Change (IPCC), International Institute for Applied Systems Analysis (IIASA) and the Stockholm Environment Institute (SEI), etc.
- General public with the advent of citizen science and crowd sourcing, e.g. EarthWatch Institute, Russian Association of Indigenous People of the North Siberia and the Far East (RAIPON) and a variety of faunal and floral atlasing projects.

*Alignment Opportunities and Constraints*

With the current state of technology and technically savvy stakeholders, it is becoming easier, at a higher level, for many concerned with the processes of environmental systems creation to speak and understand the same language and have a common understanding of available technological opportunities and limitations such as interoperability and access to high speed networking. Once again, it is important to ensure that not all the members of society have an equal understanding of technology and information, it is therefore important to ensure that user needs are fully catered for in any development of an Environmental Information System.

*Impact Assessment*

With suitable technology, information flow can succeed across different geographic and social levels, from local to global and across environmental and socio-economic themes. It is also important to remember that although system operation can be automated using technology, the human component is still needed in order to ensure systems are provided with the correct information to be analysed and disseminated, “the Human eye on earth”.

### 2.3.3 Environmental Information & Communication - Overview of Past 20 years

*Setting the Foundation*

Definitions

Information in any sector is only relevant if it is communicated to the right people (users) at the right time in the right format. The discussion around the communication of Environmental Information (EI) in this White Paper looks at the three components making up the relevant communication of EI.

The essential definitions relating to this include:

> Communication: “the imparting or exchanging of information by speaking, writing, or using some other medium”. This definition highlights the directionality of the flow of information,

an issue that has and will play an important role in Environmental Information Systems (EIS).

User: "The receiver of information". This user might be an end user "the user who uses information with which decisions are made", intermediate users "users who manipulate, change or add value to information which will ultimately be used by end users".

Format: "the organization of information according to pre-set standards and specifications which allows a wide range of users to understand and use the information".

The History of Environmental Information Communication

Historically, environmental information has been communicated through peer reviewed scientific literature from technical experts to other technical experts. During the 1970s, there was a focus on data input rather than data output. This approach had a limited outreach to the public, as there was little distillation of the raw data into useful and usable information for anyone but the technical experts (Haklay, 2001). With the advent of the Internet there was now a ubiquitous medium for information delivery. The launch of search engines such as Yahoo and Google made the discovery of data and information easier, but until recently these data and information was still only applicable to the small technical part of society.

In 1972 the United Nations Conference of the Human Environment opened the door to the free access to environmental information and data to the public, however, communication structures were simple with little emphasis on 'information flow'.

The 1990s saw a refocus on the communication of EI, with the Rio Summit and Agenda 21, focussing on the importance of EI. This re-focus meant that there was now a vision that information would become a source for promoting environmental knowledge and creating decision making competence, leading towards sustainability (Pillmann, 2002). This vision, however, was ahead of the technology at the time. It is only in the past decade, with the launch of technologies such as Web visualisation, Web 2.0 and smart mobile phones, that this vision has started to realise its potential. The understanding of user needs was also out of step with the vision, there was a proliferation of data, but not a good understanding of how users wanted the data distilled into usable information.

Various 'information systems' have been designed with specific users in mind. Environmental Information Systems (EIS) were originally focussed on presenting environmental information in a thematic and issue-based manner, but did not accommodate the need to integrate multiple data sets and contrast them (Haklay, 2001). With the implementation of EISs, a gap was highlighted between the conceptual framework of a 'user' and the technologies applied to environment Information by the technologists. This approach failed to fully address 'user needs' by failing to acknowledge that the communication of EI was directly linked to public and political awareness of environmental issues, and public participation in environmental decision making. The identification of this gap lead to the development of Public Environmental Information Systems (PEIS) for use by

user groups which ultimately took into account the multiplicity of needs and views (Haklay, 2001) and acknowledged that the conceptual framework of each user is unique and is related to a specific task and its achievement.

So, what has been learnt this past 20 years? Studies revealed that the public and decision makers have a low interest in raw data but rather in pre-processed and interpreted information (Haklay, 2001). Many EI websites remain unstable sources of information and are largely temporary and are only maintained if there is a regular user need or long-term for corporate services. Although the number of environmental websites had boomed, the content of these sites remains trivial, contains mostly old non-documented information which are often inappropriate for referenced academic use due to a the lack of verified trust in the content.

Web based EI provides internet users with a broader access to environmental topics, but to be effective, the EI 'messages' need to reach an audience beyond those who use the Internet, or any computer based system and as such must be delivered through creative and innovative communication methods.

Where are we currently?

Agenda 21, Chapter 40 on information for decision-making outlines the needs of improved capacities for information management to make environmental information better accessible at all levels. Therefore, the collection, management and communication of environmental information are nowadays seen as an essential prerequisite for sustainable development.

Environmental Communication is seen as a link process between sources and the recipients of environmental information (Pillmann, 2002). It is usually connected with environmental education, public participation and environmental politics, where communication of environmental data and information between different audiences who happen to use different media. It is a baseline for forging social, economic and political relationships with the environment. The positive wins are environmental literacy, improved understanding of the environment, as well as, the adoption of sustainable environmental practices. Pillmann (2002) perceives environmental communication as an environmentally relevant information flow which involves both communicators and audiences and suggests that this is achieved through coding, effective message delivery and interactive listening.

The media, both electronic and printed, is used to deliver environmental information to the interested citizen, the general public authority, government officials and other journalists within the media environment. The extent of the interaction between reporters and environmental providers is largely one of locating, extracting and broadcasting information and topics of interest to the audience. The success of the delivery of the intended information depends on whether or not it is useful in order to improve the sales of the product. This, however, does not apply to every country in the world. In the Middle East, the percentage of environmental issues in reports, interviews and debates is very low when compared with European countries.

Traditional methods, like community meetings, radio, television, and newspapers, have long served to inform communities and organizations on the ground and continue to have relevance. With the addition of new communication tools like mobile phones, SMS, and social media, individuals, communities and organizations are now complementing these traditional forms of media (and even challenge subversive narratives) by communicating environmental information. In addition, new tools for communication facilitate more information gathering and interactions between users. In their application to environmental information dissemination, these new tools can and are contributing to greater knowledge about environment and sustainable development. New technologies change what information can be gathered and who can participate in the communication. The penetration of mobile technologies his increased, and is now one of the most available forms of communication around the world.

The continued technological flexibility of computers has allowed for the provision of a technology that can support different views, different users, data sharing and collaborative filtering.

Technological advancements have benefited designers and positively influenced the development of new applications and significantly improved or upgraded older applications such as surveillance systems. Previously used in the military for security purposes, today it assists with determining if nature conservation goals are being met or if food security is under threat and can help with identifying problems that need to be addressed. Its main function is to collect data for research that will provide sufficient evidence to support decision making.

Advancements have been the establishment of Environmental Information Networks, e.g. Environment Information and Observation Network (EIONET), Africa Environment information Network (AEIN), Environment and Natural Resources Information Network (ENRIN) programme, and State of the Environment Reporting Information System (SERIS). Their role has been, amongst others have been the provision of EI and the highlighting of environmental issues with media that improves ease of accessibility to users.

A good example of an information network, with relevance to Environmental Information is the Geographic Information Knowledge (GIK) Network. GIK was established to enhance communication and freely share knowledge among professionals in the geographic information global community. This is a participatory user created and maintained network. The intended users are professionals, government agencies at all levels, non-government organizations (NGO's), private companies, practitioners, scholars and students across the globe who have sincere interests in creating a geographic information "knowledge network" and advancing the practice and science of the discipline.

Other networks include Wiki-based Networks, e.g. EIONETABC. These are a web solution used to support existing knowledge exchange processes with information to the network added by the users. The downside of this type of network is that information may not be absolutely correct as, in many cases, it is not peer reviewed.

Registries are another example of a network that can and is being used for Environmental Information. They have proved invaluable in that they provide a source of updated environmental information. An example of an efficient registry is the Pollutant Release and Transfer Register (PRTR) which is a national or regional environmental database or inventory of potentially hazardous chemical substances and/or pollutants released to air, water and soil and transferred off-site for treatment or disposal. An example of a publically accessible registry is the Geographic Information Community Registry, which is a facility that is intended for collective intelligence whereby each community member acts responsibly and makes individual decisions on what and how much to contribute.

Key technologies impacting the communication of Environmental Information

The number of Internet users also continues to increase as the penetration of both fixed and mobile broadband becomes more accessible around the globe. The use of Voice over IP (VoIP) communication services is becoming more popular and China has quickly established itself as the world's biggest user of VoIP services. Social networking such as Facebook is also impacting on society and has expanded its offerings beyond just social communication. Whilst Facebook has managed to capture the largest share of the market in recent years, the industry is not sitting still and new social networks are again emerging such as Google+, LinkedIn, etc.

Of global importance is the telecommunications industry, which continues to transform, and despite the economic downturn, persists; and grows. Mobile technology has become a pervasive technology, which with smart phones and improved infrastructure fuel the uptake of mobile technologies around the world.

Cell phones may change how governments monitor the environment. It empowers the public to monitor the local environment (UNECE commissioned study). By 2012–14, the world may have nearly 5 billion users (Charles Geiger, Special Adviser for the UNCTAD Secretariat on the Commission on Science and Technology for Development (CSTD)).

Telecom infrastructure varies from rudimentary or even non-existent in some of the poorer rural areas to well advanced in the major cities. Despite a low 19% teledensity (in most Western European countries teledensity ranges between 40% and 60%), fixed-lines in service have grown little since 2001, with consumers favouring mobile devices over traditional phones. Panama has become one of the first countries in the world to offer free wireless access nationwide with a speed limit of 256Kb/s, reaching 80% of the population.

Third generation (3G) mobile technologies, coupled with improvements in international fibre and national backbone network infrastructure are now capable of delivering broadband Internet access to a wider part of the South American continent's close to one billion population. However, the price of end user devices will be a key factor. The prepaid mass market will only adopt advanced services on a broad scale once prices for 3G handsets and modems as well as personal computers have reached affordable levels.

Short Message Service (SMS) still accounts for the bulk of Africa's mobile data traffic and revenue, but in recent years there has also been an increasing interest in Multimedia Messaging Service (MMS) and other forms of mobile messaging and social media, downloads of ring tones, logos, music and games, as well as SMS-based information and lifestyle services. Premium rate and bulk SMS services are generating millions in revenues. Third parties are continuously developing new value-added services and applications.

Mobile T.V. services have been launched in at least ten African countries. M-payments and mobile banking is another key growth area that is revolutionizing Africa's financial sector, where only a small percentage of the population has access to traditional banking system. In the continent's most advanced markets, m-commerce, mobile content, applications and media have reached a level of development that is beginning to foster an associated advertising and marketing industry.

The success of smart phones has changed the face of the mobile sector and in 2011 it is no longer possible to discuss this industry without acknowledging their impact. The resilience of the mobile sector under such challenging market conditions can be partly attributed to the continuing growth of smart phone sales, which now account for around 20% of all handset sales on a global level. Smart phones have become particularly popular in the developed markets where they offer a more user-friendly and interactive alternative; while this trend will continue for the near future, Asia, particularly China, will lead the growth in the developing markets. Other developed nations in Europe, North America are close behind.

In recent times, the Internet has been chosen as a main environmental communication tool to reach the widest possible audience, at the same time enabling the cost-efficiency of production and the employment of user-friendly formats for information presentation, in particular visualisation. The availability of Internet service worldwide is growing dramatically, and even in regions with yet limited access to Internet, its potential for channelling information to the international audience is commonly recognised. The use of the Internet also makes it possible to routinely produce a wide range of derivative electronic (CD-ROMs) and paper products for their distribution in less technologically-developed areas.

We are living in an age where there is abundant information available, much of it through Web-based systems. As many users still have limited access to this medium, there is the need to consider and accommodate the widest range of users. These include users with limited ICT knowledge, occasional users or users coming from a range of socio-economic and cultural backgrounds. Only when these groups are considered thoroughly, the outreach element (increased awareness) can be achieved. Another aspect that deserves attention is to gain a better understanding of local informal networks, and to improve information acquisition and provision to support information intermediaries. Furthermore, there is a need to develop EISs that integrate gender-related environmental and socio-economic data.

*Issues, Challenges, and Opportunities*

Challenges

Networking and coordination mechanisms between data producers and users at all levels are a challenge in environmental communication. The principle of networking revolves around collaboration and partnership. Therefore there is the need to look at possibilities of building effective partnerships with policy makers, politicians, other users and the technical experts at all levels.

*Direction and Way Forward*

Environmental information needs and communication relate mainly to respondents' day-to-day activities, with a mix between livelihood issues, quality of life, and health issues.

Setting the stage

The synopsis of the history of communications and the current status shows that communication networks are reaching more and more of the world's population. However, there is very little analysis of the effectiveness of these networks from the point-of-view of the societies and economies that are following paths to sustainable development.

One must also consider the common saying, "Communication is a two-way street".

To set the stage, the following sets of questions that need consideration are:

- Is this advanced ICT, and the environmental information it delivers, meeting the needs of all sectors of the world's population (both vertically and horizontally)?
- Should all levels of society (individuals, communities, private entities and public institutions) be empowered to make informed decisions about the economy, society and environment?
- Is there sufficient communication from the intended recipients of the environmental information to the providers about what is important to them, for example,
- What information is need, e.g. what problems and what places are they interested in?
- How will the information be used, e.g. the tools that might be used and the decisions that may be made or influenced?
- Is capacity building needed to effectively use the information (training, infrastructure)?
- Are there specific information gaps that hinder the ability to address user interests?
- Are there specific needs for real-time or near-real-time information?
- Are there opportunities to provide feedback to the information providers and the communication system operators in order to improve the information?

Trends and desirable directions forward

Several trends in environmental decision-making are to some extent driving the need for better and

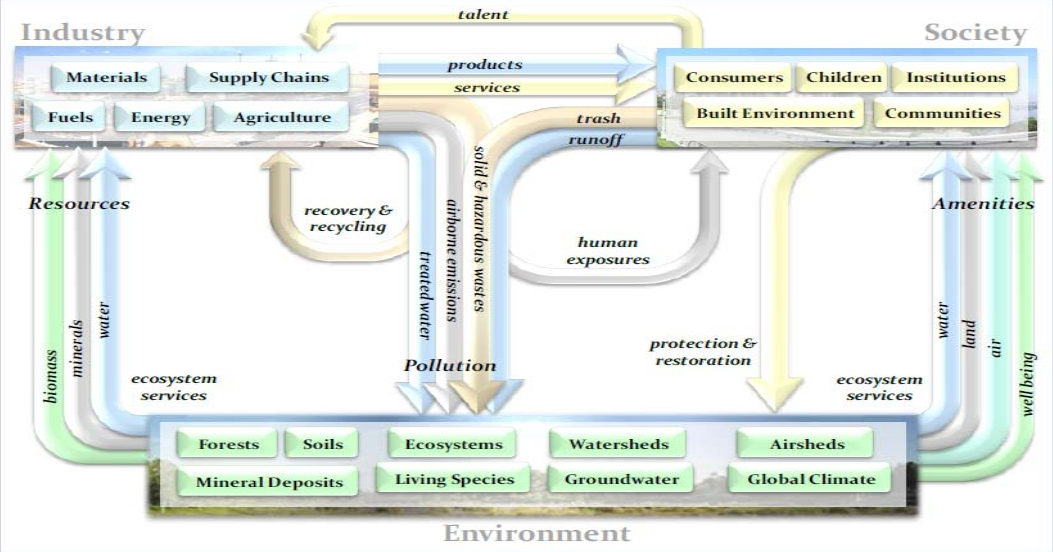
more focused information:

- The insufficient effectiveness of mitigation approaches for meeting environmental objectives.
- The need for real-time or near-real-time data to support adaptive management as a supplement to mitigation.
- The consideration of trade-offs and alternatives in decision making.
- The maximization of benefits and the minimization of costs within and across the pillars of sustainability — environment, economy and society.

These drivers greatly increase the information needs, going well beyond the information that assists with simply issue identification and is often readily available.

It also needs to recognised by both information providers and communication network operators that meeting user needs almost always requires engagement of the users such that all parties clearly understand the needs. In addition, it is also important for all to know where capacity building within the user community may be required to achieve success.

Consider the following systems diagram (Joseph Fiksel, USEPA, 2011) that depicts the components of sectors of Industry (economy), Society and Environment, and the resource flows between these sectors. This provides a starting point for analyzing the problem, identifying the components and flows that either are changing or could be affected by decision making to address the problem. From this initial work, components and flows that are not involved can be removed, providing a simpler diagram that, from the users' perspective, is sufficient to address the problem.




***Components of sectors of Industry (economy), Society and Environment, and the resource flow between these sectors.***

Users can also identify which information is needed to establish a resource flow baseline and where trend information is needed for selected indicators to better illustrate what changes have occurred that have occurred that may be part of the problem.

This seems at first glance to be very complex, but in reality it can provide a “big picture”, macro-level analysis of the problem and possible solutions often from already available information.

The users, namely the decision-makers, learn from a “big picture” analysis like this one. They then are better able to define needs for environmental information. They can better seek out the information that will help them decide where mitigation may be effective and where it needs to be supplemented by adaptive management. Then they can see which critical indicators are need to track and ensure that the problem is really being solved. Finally, they can determine where advanced communication systems will assist with the post decision-making implementation.

Clearly environmental problem solving, combined with sustainable development approaches, hinges on sufficient, reliable and comparable information, indicators, free access to information and unhindered ‘information flows’ .

Future

The Global Spatial Data Infrastructure (GSDI) Association was founded in order to promote international cooperation and collaboration in support of local, national and international spatial data infrastructure developments that will allow nations to better address social, economic and environmental issues of pressing importance.

Continued dialogue and information exchange between users and providers is necessary. Participation of the public in environmental dialogue promotes public awareness for safeguarding natural resources and informs government departments about public concerns. It also promotes transparency of government action.

The promotion of safeguarding the fair and equitable sharing of benefits arising out of the utilization of data and information resources must be upheld as outlined at the World Summit on Sustainable Development, in Johannesburg, in 2002.

Technologies that will play an ever increasing role in the communication of Environmental Information include:

- Cloud computing,
- Crowd sourcing,
- Social networking,
- Web 2.0 and
- Smart phones.

*Crosscutting issues*

An awareness among government organisations regarding the types of environmental information that are available from other organisations is poor. Information sharing in favour of recapturing existing data is time saving, labour saving and cost effective. The promotion of information that is of common interest to many government departments is needed. This issue is in fitting with WG1 – Policy, Governance and Institutional Networking.

The integration of crowd sourced data with traditional environmental data on a cultural level was identified by WG5 – Applications Showcase as being a new paradigm. In order to deliver a real-world impact, there is a need to digitise legacy data and link indigenous people's perspectives into visualization techniques and products.

With WG4 – the need to develop capacity amongst the scientific and technical community to enable them to be able to better communicate environmental messages to the broader community. Conversely it is also important to build the communities capacity to enable them to better understand more scientific information.

### 2.3.4 Capacity from a User Needs Perspective

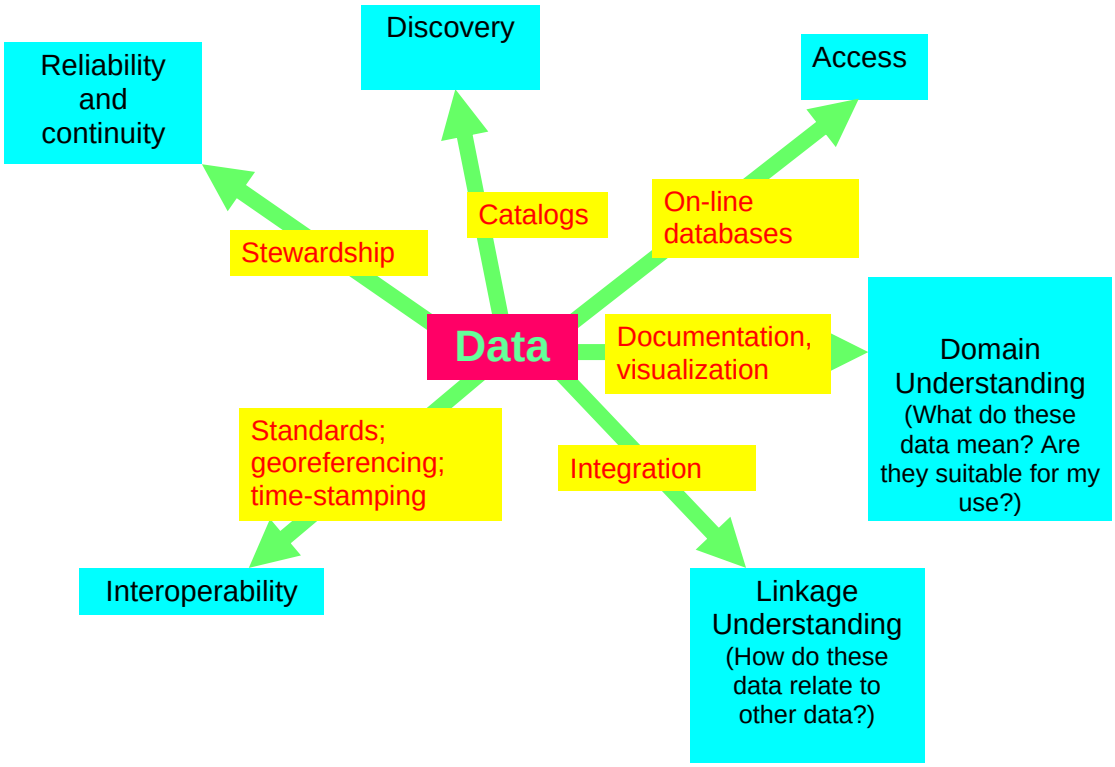
*Setting the Foundation*

We have learned over the past decades that environmental information systems (EISs) are not merely collections of data, hardware and software. Critical functions require intensive human engagement, and if these are not provided the systems are not effective. These functions include the following:

- Maintaining strong working relationships with users.
- Staying abreast of changing science, policy agendas, and technology.
- Providing custodial services to data and information, including those related to documentation, cataloguing, metadata, archiving and quality assurance.
- Providing data quality and assurance.
- Summarizing and synthesizing information.
- Creating integrated data products and services.
- Publishing data in Web services.
- Interpreting data and information to make them understandable and usable.
- Reformatting data.
- Content investment and development must be paced with the ability of individuals and institutions to use it at some level that justifies the cost versus the benefit. This has implications at multiple levels from community to global.

*Alignment Opportunities and Constraints*

There are relevant initiatives that would need to be part of a coordinated approach, including Capacity 21 and Paris 21; GSDI initiatives; World Bank and other regional banks; international science associations; SERVIR and related initiatives. Coordination at the highest level of generality is not likely to bare fruit, but coordination focused on a specific region or issue is likely to be relatively straightforward. Capacity building efforts that tie into major international priorities such as disaster resilience or climate adaptation may be easier to obtain support.




***A Spectral Range of User Needs and Levels of Capacity.***

User needs (in the outer circle in green boxes) dictate a range of capacity needs (in the inner circle in yellow boxes). Because effective environmental information systems must meet the full range of user needs, they require adequate levels of capacity across the full spectrum. Capacity needs should also be considered in parallel to user needs.

Stakeholders

Relevant stakeholders include the following:

Operators of EISs in countries that experience low levels of capacity.

Operators of EISs that are located in high-capacity countries but which lack adequate capacity for their own systems.

Issue and policy communities suffering from "thin" EISs that lack full relevant capacities.

Impact Assessment

Measuring impacts of capacity building efforts is notoriously difficult. Special attention should be devoted to the functions discussed here. It would be worth cultivating a community of practice around the issue of impact evaluation of EISs.

*Crosscutting issues*

The WG4 White Paper on Capacity Building explains very clearly how these issues shape the effectiveness of environmental information systems and what kind of strategies are most promising for making progress. A very basic point that must be emphasized is that there is a widespread tendency, unfortunately, to underinvest in these critical capacity needs and that correcting this condition is critical for success.

### 2.3.5 Sufficient information to characterize state, trends and outlooks of the environment

*Setting the Stage*

There is an ever increasing need to characterize and monitor the status, pressures on, and trends of the environment at national, regional and global levels, and to model and predict trends into the future under different scenarios in order to better influence and inform decision-making. The Millennium Ecosystem Assessment - the most extensive study ever produced linking human well-being and the state of the world's ecosystems – noted that loss of biodiversity due to human activities was more rapid in the past 50 years than at any time in human history. The assessment noted that many people have benefited over the last century from the conversion of natural ecosystems to human-dominated ecosystems, but that these gains have been achieved at growing costs in the form of losses in biodiversity, degradation of many ecosystem services, and the exacerbation of poverty for other groups of people. More recently, one review published in the journal *Nature* has demonstrated that three of nine "planetary boundaries" have been exceeded: human interference in the nitrogen cycle, climate change, and rate of biodiversity loss.

The need for improved environmental monitoring is driven explicitly (albeit not only) through international mandates. For example, Goal 7 of the United Nations Millennium Development Goals to "Ensure environmental sustainability" requires measurement against four explicit targets. Evidence already shows that at least one of these, Target 7B, has not been met. Likewise, two of the three UN conventions – the United Nations Convention to Combat Desertification (UNCCD) and the Convention on Biological Diversity (CBD) – have agreed 10-Year Strategic Plans with specific measurable targets. In the case of the CBD, in 2010, the 193 Parties to the convention have agreed a Strategic Plan for 2011-2020 to "*take effective and urgent action to halt the loss of biodiversity in order to ensure that by 2020 ecosystems are resilient and continue to provide essential services*". Currently, a revised suite of indicators is being formulated to measure progress against the 20 targets of the new Strategic Plan (at both the global and sub-global levels).

Environmental monitoring and reporting currently takes place at global (e.g., the Global Environmental Outlook or GEO, and the Global Biodiversity Outlook, GBO), regional (e.g., the African Environmental Outlook), national (e.g., UK National Ecosystem Assessment) and sub-national levels (Figure 1). Since 1972, UNEP has had a mandate to review the global environment.

This has been fulfilled in two main ways: 1) establishing a common methodology for the assessment of environmental developments; 2) preparing reports on the state of and outlook for the environment for regions (e.g., African Environment Outlook, AEO) and internationally (the fifth Global Environmental Outlook - GEO-5 - is due to be published 2012). UNEP's Department of Early Warning and Assessment (DEWA) implements the UNEP mandate with the following mission: provide the world community with improved access to meaningful environmental data and information, and to help increase the capacity of governments to use environmental information for decision making and action planning for sustainable human development.


***Examples of ongoing environmental reporting at the global (Global Environmental Outlook), regional (African Environmental Outlook), national (Bahrain) and sub-national (Abu Dhabi) level.***

Current environmental monitoring programmes suffer from several constraints including: incomplete and biased spatial and temporal coverage; lack of compatibility between data sets owing to different collection methodologies; and insufficient integration at different scales. Initiatives such as GEOSS – the Global Earth Observation System of Systems, coordinated by the Group on Earth Observations – are intended to help overcome the latter two of these constraints, in particular by improving decision makers' access to information. However, there remains a critical

need for investment in coherent global environmental and biodiversity monitoring infrastructure to enhance the provision of key environmental data for the purpose of measuring progress against agreed targets and thereby better informing future decision-making processes.

*Alignment Opportunities and Constraints*

Issues

- What is the current state of the environment and how is it changing?
- What are the pressures and underlying causes / drivers?
- Where are pressures concentrated, and where are changes in status and condition taking place?
- What are the implications of these changes on the environment for human livelihoods and well-being?
- What responses are having positive impacts on trends in the status of the environment?
- plausible future environmental conditions might exist under different scenarios?

In order to adequately answer and address the issues above, improved information and data is required across a suite of domains, such as freshwater (e.g., water quality, water scarcity, water consumption and demand), climate (e.g., greenhouse gases, temperature, precipitation), energy (e.g., per capita consumption, percent of renewable energy used), marine (e.g., water quality, hydrocarbons, fisheries), biodiversity (e.g., land-use change and cover, population trends and abundance, changes in species extinction risk, protected area coverage) and socio-economics (e.g., population growth, per capita income, population density, life expectancy, education, consumption patterns).

Challenges

Several challenges need to be overcome in order to produce a reliable and comprehensive assessment of environmental status and trends, either at global or sub-global levels:

- Improving and expanding environmental monitoring systems and capabilities in order to improve and remedy current spatial biases as well as temporal gaps
- Improving access to reliable and standardized monitoring information
- Encouraging collation of monitoring data required to report against accepted indicators for monitoring environmental status and trends
- Encouraging and incentivizing regular and systematic reporting
- Strengthening and improving national and regional capacity, both in terms of training and the use of technology, for better environmental monitoring and reporting systems (this is a

cross-cutting issue that relates to the activities of Working Groups 3 on Technical Infrastructure and 4 on Capacity Building).

- Improving centralized or at least coordinated curation and management of environmental data (environmental data are often dispersed between environmental agencies / authorities and/or within research institutes or non-governmental and other organizations).
- Securing adequate financial resources in developing countries, and developing necessary legislation.
- Improving environmental awareness and computer illiteracy amongst users, and encouraging participation in environmental monitoring and reporting through citizen-science

Stakeholders

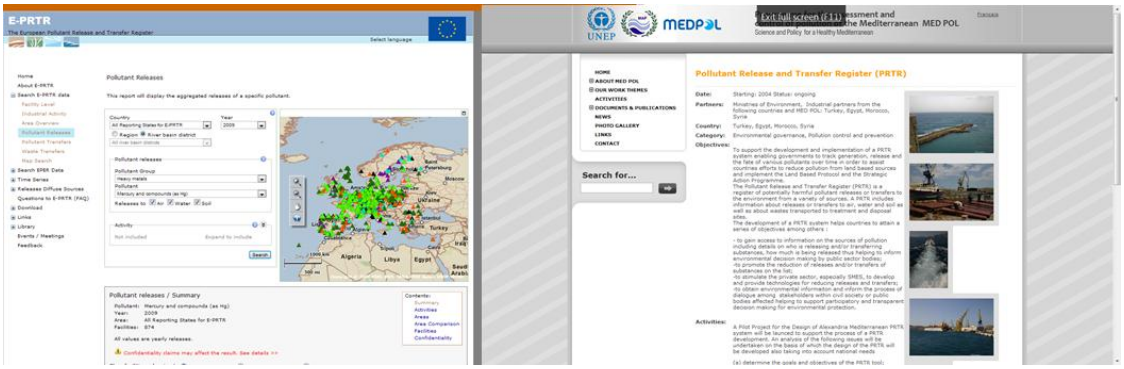
- National agencies and authorities who generate and hold environmental data and other relevant data (socio-economic, industry, transportation, etc..). Decision-makers operating at the national scale.
- Regional organization dealing with trans-boundary environmental issues and shared ecosystems (for example: Regional Organization for the Protection of the Marine Environment, ROPME; ROPME Integrated Information System; Mediterranean Pollution Monitoring Programme)
- International organizations and agencies dealing with the environment, such as Food and Agriculture Organization (FAO) and IUCN which is custodian of the IUCN Red List of Threatened Species.
- Non-governmental organizations
- City and other local-scale data custodians and decision-makers.
- Academic / scientific community
- Communities and individuals (citizen-science).
- Private sector

*The Way Forward*

Opportunities

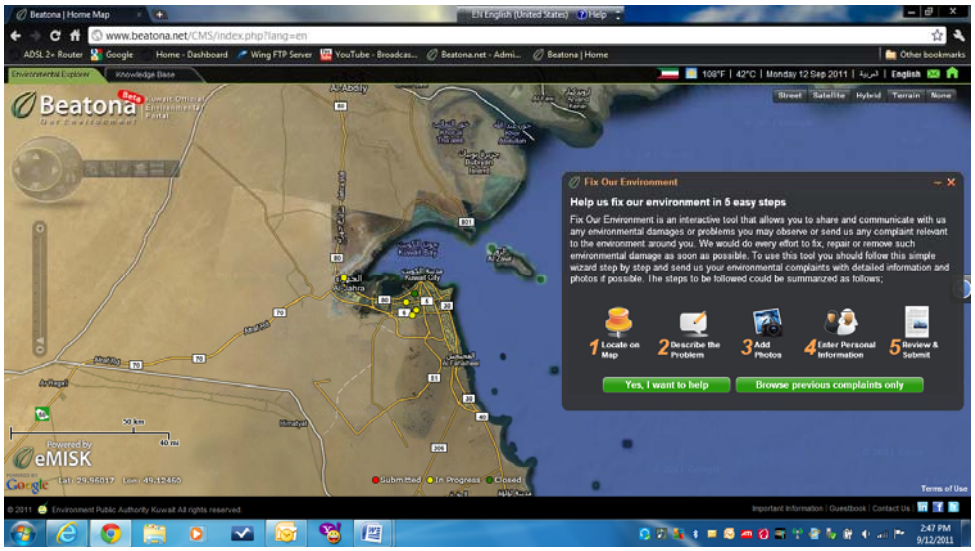
Many, or most, countries already have mandatory reporting requirements, at national, regional and international (mostly MEAs) levels. For developing countries, there is the opportunity to obtain financial and/or other (e.g., technical) support from funding agencies (e.g., the Global Environment Facility) or from inter-governmental or non-governmental agencies. For example, the UNEP-MAP –

UNEP-Mediterranean Action Programme – provided technical and financial assistance to establish a Pollutant Release and Transfer Register, PRTR, for Turkey, Syria, Egypt and Lebanon (Figure below). Likewise, the Swiss Development Corporation provided financial and technical assistance to establish hazardous substances information management system for Syria, Jordan, Egypt and Lebanon.



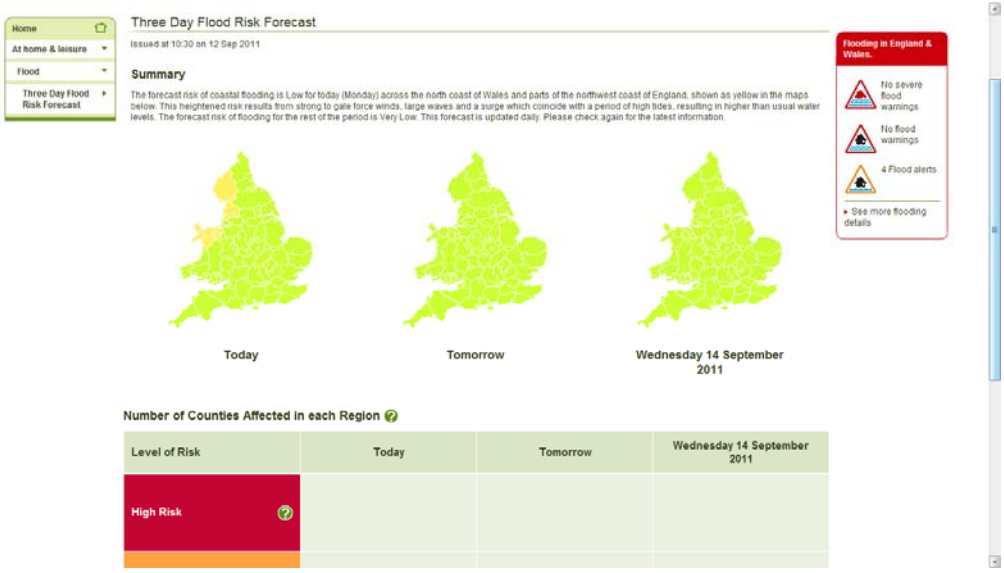

***The Pollutant Release and Transfer Register (PRTR) is a register of potentially harmful pollutant releases or transfers to the environment from a variety of sources.***

Growing advances in technology, such as mobile technology, social media, geo-spatial information systems, data visualization tools, and so on, present opportunities to encourage better public participation in environmental observations, monitoring and reporting, and also to communicate the results of environmental monitoring more effectively and engagingly to the public (Figure below).




***The Environmental Information Monitoring System of Kuwait (eMISK) publishes and distributes environmental data through the Beatona website.***

Adequate environmental information systems will have significant impacts and improvements on how to keep the environment under continuous observation and surveillance, produce timely environmental data and indicators, and enhance the process of environmental reporting on the local, national, regional and global levels. Moreover, these systems enhance public awareness as well as the decision making process at all levels. It will provide a basis for monitoring, research, assessment and early warning. Examples include flood prediction maps (Figure below), which have enabled proactive evacuation and disaster mitigation (e.g., the Hurricane Irene on the east coast of the US).




***The Flood Forecasting Centre (FFC) in the UK is a partnership between the UK Environment Agency and the Met Office, combining meteorology and hydrology expertise to forecast river, tidal and coastal flooding***

### 2.3.6 Support Environmental Governance

*Setting the Foundation*

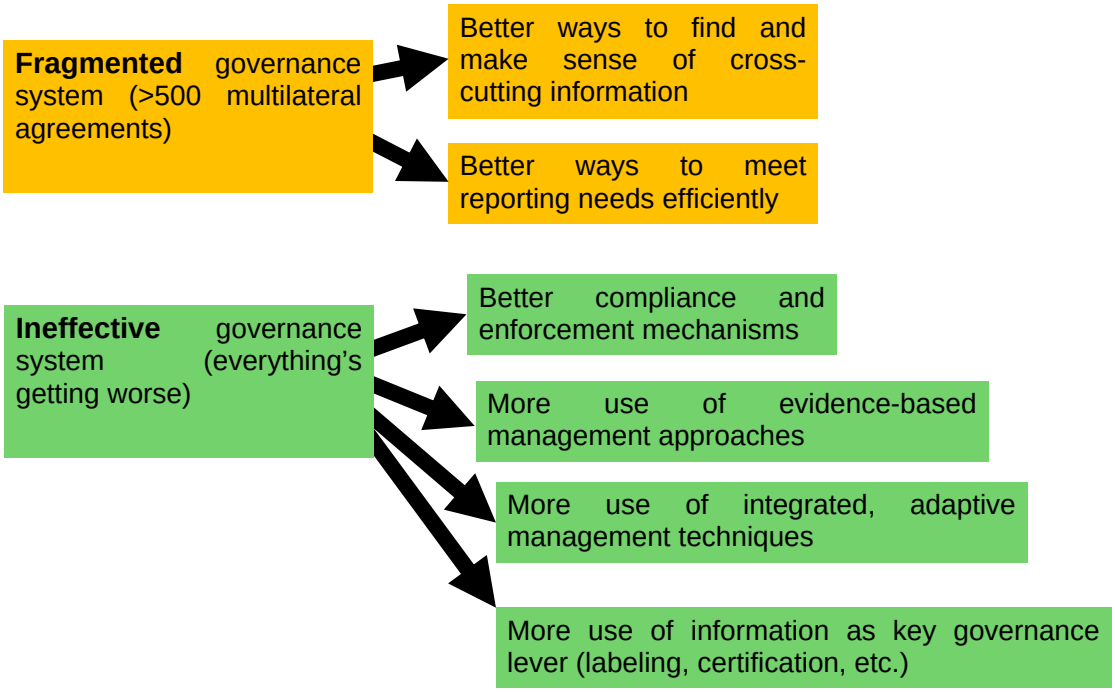
There is a strong desire to improve environmental governance. The approaches under consideration would all benefit significantly from improved environmental information systems. Many suggested reforms call for multilateral environmental agreements to improve compliance and enforcement mechanisms; such reforms require effective information comparing behaviour to obligations. Other proposed reforms call for integrated adaptive management approaches. These are heavily dependent on reliable, high-quality information. Still other proposed reforms call for increased reliance on results-based management across multiple stakeholders. Such an approach requires information that can support target setting, monitoring and evaluation. Other proposed

reforms call for greater use of certification and labelling mechanisms; both of which depend heavily on environmental information.

**Issues, Challenges and Opportunities**

Environmental governance is a major theme for **Rio+20**. The current state of climate change negotiations is raising intense interest in environmental governance on top of the review engendered by **Rio+20**. Consideration of the relationship between environmental information systems and environmental governance will be enhanced by these considerations.

Two key issues regarding governance are that it is often fragmented and that it is ineffective.




***The Issues and Solutions Concerning Governance Relevant to User Needs and Content.***

*The Way Forward*

From an information and user needs perspective there are things that can be done to improve this situation. The fragmentation of Governance can be addressed by finding:

- Better ways to find and make sense of cross-cutting information.
- Better ways to meet reporting needs more efficiently.

Ineffective Governance can be addressed by finding:

- Better compliance and enforcement mechanisms.
- Greater use of evidence-based management approaches.

- Greater use of integrated, adaptive management techniques.
- Greater use of information as a key governance lever (labelling, certification, etc.)

The key points are that:

- Information needs to help shape, and be shaped by, environmental governance.
- Governance and incentives can shape what information is most needed, can determine how to make it available and can make it more accessible to various communities and can determine how that process may in turn influence government policy, planning and organization.

*Crosscutting Issues*

This issue has very close alignment with WG1. It is proposed that this be further developed between the two WGs in order to develop a discussion point for Day 3 of the Summit.

### 2.3.7 Integration of Environmental and Socio-economic Data is lacking

*Setting the Foundation*

Environmental data and information systems focus on the physical environment. However, effective decision-making also requires information on various aspects of regional development, which often is not so easily obtained, especially in developing countries. Besides the data paucity, socio-economic information is very different in its geographic properties to environmental information.

Up-to-date and reliable information is vital for the management of a region's human and natural resources and for dealing with regional development decisions. A comprehensive information base reduces uncertainty and enhances decision-making. Managers and policy makers need to integrate social, economic and environmental data in order to formulate strategic development plans. In developing countries there are obvious data barriers, namely, institutional and technical barriers. As institutional issues are being recognized and governments start to invest in collecting data, data management and usage are still far from a satisfactory level. Information on various aspects of regional development such as social, economic and environmental is originally collected for different purposes, at different scales, at different time frames and with different underlying assumptions about the nature of the phenomena. This creates technical difficulties regarding the integration of social and environmental data, and explains the scarcity of successful empirical research on regional development analysis in developing countries.

Environmental data often exhibits continuous spatial variation (e.g., elevation, soil, precipitation, temperature) while socio-economic data tends to be more spatially discrete (e.g., people, farms, factories and administrative units).

The triple bottom line ("TBL" or "3BL") or "people, planet, profit" approach, which captures an expanded spectrum of values and criteria for measuring economic, ecological and social success obviously also depends on having the proper data available. With the ratification of the United Nations in early 2007, TBL is the dominant approach to public sector full-cost accounting. Similar UN standards apply to natural capital and human capital measurement to assist in measurements required by TBL, e.g. the ecoBudget standard for reporting ecological footprint.

*Example of integration of environmental and socio-economic data*

Poverty can only be reduced when the underlying mechanisms are properly understood. This starts with a description of spatial distribution of poverty, followed by an analysis that explains and potentially predicts that distribution. Poverty maps are traditionally produced by exploiting links between census (wide area) and survey (smaller area) data. The relationships found within the survey data are extended to the census data that must share some predictor variables with the survey data. Both census and survey data tend to be socio-economic in nature. The mapping exploits the internal correlations – one 'measure' of poverty is often correlated with another. Many of the dimensions of poverty are environmentally related: people are poor because they are unhealthy, under-fed, and without access to fuel and water. Each of these is environmental in some way or other, and an approach to reducing poverty might be to identify environmental causes. Whilst correlation obviously does not automatically imply causation, an environmental approach is more likely to reveal causes than the traditional approach of small area mapping using census and survey data.

Crucial here is that "environmental data can improve socio-economic decision making" and "socio-economic data can improve environmental decision making".

Integrating environmental and socio-economic data thus fits multiple challenges:

- The solving complex problems that intersect the environmental and socio-economic domains (gender equality, poverty, food- and water-security).
- The making more informed and thus more effective decisions on all levels (regional, international, national, provincial, local).
- The describing of trends and states, providing information on drivers and identifying pressures for the formal "environmental outlook" process.
- The carrying out of TBL full-cost accounting.
- The detection of emergent problems.

Integration of the data can occur in two different ways:

1) Integration of the data in a unified repository. This requires upfront investment in resources, and is structured according to anticipated problems. It is activity-based approach.

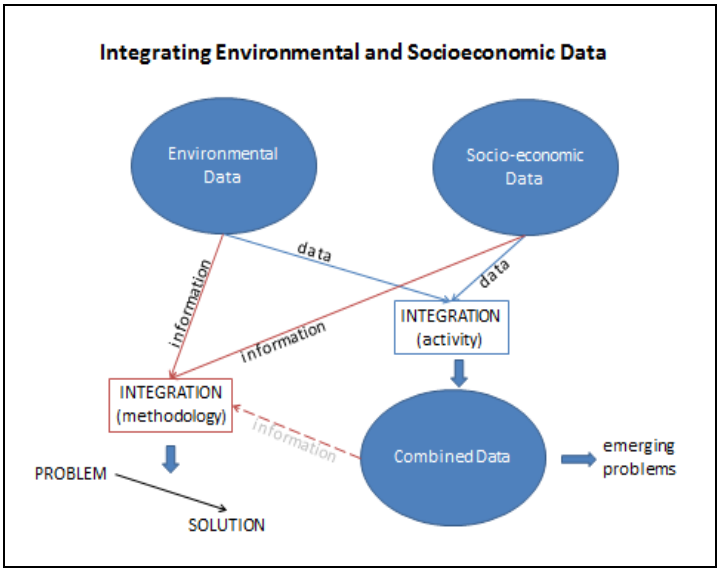
A main application of the unified repository is the identification of new (emerging) problems.

2) Integration of the information in the data as a methodology contributing to the process of getting from a specific problem to a specific solution using both environmental and socio-economic data. This is a problem-driven approach, so no upfront investments are necessary.

**Table: The integration of databases and information.**

| | **Integrate databases** | **Integrate of information** |
|---|---|---|
| Description | A unified database that contains all data, environmental and socio-economic, using harmonized spatial and temporal resolutions. | A methodological approach that describes how environmental and socio-economical information can be combined to support finding solutions for specific problems. |
| Upfront costs and efforts | A lot of effort and resources are needed to combine the separate databases. | No upfront costs, as the integration of information from the separate databases are driven by a specific problem. |
| Application | Detection of emerging problems and support towards finding solutions for problems using "all" information (under the *proviso* that the problem is covered by the database). | Focused on solving specific problems, in a well-defined context. |
| Caveats | The form of the data "structure" is dictated by the data itself (environmental or socio-economic), not by the integrated database; this is because the databases being integrated can have very different temporal and spatial resolutions (i.e. death-rates vs. fine-dust concentrations). Harmonization will be challenging.<br><br>The harmonization process needs to make assumptions about the problems that are going to be solved using the resulting database; this implies a limitation and some problems will not benefit from the new database. | Part of the methodology of integrating environmental and socio-economical information is generic, but would have to be done over and over again (for every new problem) implying some inefficiency. |
| Providers | As most available data falls either in the category "environmental" or "socio-economic" where any provider could be part of the integration. Spatial boundaries (nations, regions, catchments) can be set to limit the involvement. | Only those providers that are relevant for the problem/solution pathway would be involved (but it might not be possible to identify them on forehand). |
| Users | There is no predefined user, as the integration | Users would come from the problem |

| | | |
|---|---|---|
| | takes place separate to the application. | stakeholders. |




*Two ways of integrating environmental and socio-economic data.*

*Issues, Challenges and Opportunities*

Integrating databases

The integrated database would use a structure that has two independent variables that define the temporal and spatial coordinates of the data, and the data itself. This allows for finding the data given a point in time and a location in space. The definition of the time and space coordinates determines the resolution/granularity of the data. Combining different databases would require the harmonization of these coordinates, as well as the units in which the data is expressed, and possibly the methodologies by which the data has been collected/created. Solutions need to be found for data that does not have time and or space coordinates (i.e. product-market information).

Integrating information

In a policy-making context, the user has to go through a series of steps to shift from the policy problem to a policy:

- Where are we now? (situation analysis)
- Where do we want to go? (priorities, goals and targets)
- How will we get there? (process, alternative policies)
- How will we know we have arrived? (monitoring and evaluation)
- What new problems have arisen? (planning)

The situation analysis describes the problem. What is its magnitude? Who is affected? Where are they living? What are the resources to deal with this problem? What are the present and past outputs in the area? How are resources utilized? If these resources were not utilized optimally, what were the constraints? How can those constraints be overcome? Are there enough resources to deal with the problems? If not, what extra resources would be required? Both environmental information and socio-economic information are needed here, and become integrated when answering these questions.

The other step where the environmental and socio-economic information is needed is when alternative policies are formulated.

Challenges

Significant institutional barriers complicate integrating environmental and socio-economic data. These barriers operate on multiple scales and can cause a variety of problems. In general, these fit into three categories:

1. Environmental and socio-economic data does not generally exist on the local level to support local decision making. Instead, data is only available on regional or global scales. For local communities to act appropriately, data must exist on the local scale and be accessible to decision-makers at the community level of governance.
2. Effective institutions and regulations are needed to facilitate the use of environmental and socio-economic data for the purpose of capacity building. In the absence of government agencies or NGOs there is little ability to either generate data relevant to decision making or to utilize such data. Furthermore, even if such institutions exist, they must be properly integrated into means for transmitting relevant information.
3. Flexible and dynamic systems for transmitting environmental and socio-economic data are key to its successful generation and dissemination. Currently, many of these systems for transmitting information are rigid and linear. For example, the National Adaptation Programme of Action (NAPA) process used by the UNDP and the Global Environment Facility (GEF) functions on very formal reporting procedures that do not necessarily fit well with the needs and abilities for developing country communities.
4. Ensure that metadata that focuses on integration is provided with data to ensure discovery, interoperability and re-use in multiple contexts.

The key messages are that:

- Effective policy making in a development context is strongly supported by tightly integrating environmental and socio-economic information.
- Complex problems like gender inequality, poverty, food- and water-security can only be solved through integrating environmental and socio-economic knowledge, information and data.

- Although the resources needed for integrating data in a harmonized database might be prohibitive for wide application, integration is also possible on the information level, targeted at specific policy problems.

### 2.3.8 Empower People through Open Access to Environmental Information

*Setting the Foundation*

Access to information (ATI), including access to environmental information, is the cornerstone of good governance and meaningful participation in government (http://www.cartercenter.org /peace/americas/information.html). Good environmental governance depends on knowledgeable citizens with access to a range of social, economic and environmental information. Information enables people to participate more fully in public life, hold their public officials accountable and thereby ensure sound environmental management. Inadequate ATI allows corruption to flourish and can lead to the overexploitation of natural resources, loss of ecosystem services and environmental degradation. ATI, however, must be balanced with protection of personal privacy and narrowly defined state interests, such as national security.

Explicit recognition of the right of ATI as a fundamental human right is codified in a number of global, regional and national instruments.

- *International* instruments include the Universal Declaration of Human Rights (1948), International Covenant on Civil and Political Rights (1966) and International Covenant on Economic, Social and Cultural Rights (1966). ATI is also codified in various multilateral environmental agreements such as the Rio Declaration (1992), World Summit on Sustainable Development (2002) and Convention on Biological Diversity, e.g. see decisions made in COP 10 Biodiversity Convention http://www.cbd.int/decisions/cop/?m=cop-10. Principle 10 of the Rio Declaration addresses three critical procedural rights, including ATI.
- *Regional* instruments include the American Convention on Human Rights (1969), African Charter on Human and People's Rights (1981) and the UN Economic Commission for Europe (UNECE) Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention, 1998). There are also a number of on-going initiatives such as the preparation of a model law for African Union member states on ATI (http://www.achpr.org/english/other/MODEL 20LAW%20FINAL.pdf) and the Pan-African Conference on ATI (http://www.pacaia.org/), which involves the development of an African Platform on ATI (http://windhoekplus20.org/african-platform-on-access-to-information/).
- At the *national* level, the constitutions of most countries around the world have significant bundles of procedural and substantive rights, including the rights of ATI. The more modern (post-1995) constitutions also have substantive environmental rights, such as the right to a healthy environment.

A growing number of governments are also recognizing the importance of providing an explicit recognition of a general right to ATI. New comprehensive national ATI laws have been developed in over 90 countries around the world to protect the right as part of a growing transparency movement. These legal frameworks provide a right of ATI through the proactive disclosure of information by government and citizen requests for government-held information. Implementation and enforcement challenges in countries with comprehensive ATI legislation, however, have resulted in gaps between the law and practice (http://www.humanrightsinitiative.org /programs/ai/rti/international/laws_papers/pakistan/pak_report_of_proceedings.pdf). Moreover, these legal frameworks rarely specifically mention environmental information.

While there has been growth in the development of comprehensive ATI laws over the last decade, there are significant regional differences. Most progress has been made in Europe regarding comprehensive ATI laws and environmental information. The UNECE Aarhus Convention—which incorporates Principle 10 of the Rio Declaration— promotes full implementation of the right to environmental information through strong legal principles and a compliance mechanism. This has been further strengthened by the INSPIRE initiative to establish an infrastructure for spatial information in Europe to support European Community environmental policies, and policies or activities which may have an impact on the environment (http://inspire.jrc.ec.europa.eu/). In addition new protocols have been developed under the Convention on the release of pollution data.

Under the European Economic Commission for Europe (ECE), Principle 10 of the Rio Declaration has been fully incorporated into the Aarhus Convention which promotes full implementation of the right to environmental information through strong legal principles and a compliance mechanism. ATI has been further strengthened by the INSPIRE initiative to establish an infrastructure for spatial information in Europe to support European Community environmental policies, and policies or activities which may have an impact on the environment. In addition, new protocols have been developed under the Convention on the release of pollution data.

In sub-Saharan Africa, however, only six countries have enacted a comprehensive ATI Act. The Middle East and Asia also significantly lag behind Europe and Latin America. At the regional level, the Organization of American States, Economic Commission for Latin America and the Caribbean, Economic Commission for Africa, and Africa Union have taken important steps to advance the right of ATI in Latin America and Africa. Model laws and regional decisions for strengthening the right of ATI have been developed in both regions. Regional actions, such as the National Information and Communication Initiative (NICI) of the African Information Society Initiative (http://www.uneca.org/aisi/nici/), are designed to support implementation, although progress has been slow. As a result, it is unclear what impacts these regional initiatives will have at the national level.

Regarding access to environmental information specifically, the Economic Commission for Latin America and the Caribbean is considering supporting the development of a regional convention to

promote Principle 10 through its meetings leading up to the **Rio+20** Convention (http://www.uncsd2012.org/rio20/index.php). Little attention, however, has been focused on developing regional norms to improve government capacity in providing information, on educating people on the right of ATI, and on monitoring of the implementation of ATI commitments and laws.

Some governments have adopted sectorial approaches to access environmental information under a central environment framework and specific natural resource laws (*e.g*. Brazil and Cameroon), although this approach also has certain deficiencies. For example, the information provisions in environmental or natural resource legislation often are not comprehensive. For example, they rarely provide a means of redress for citizens who do not receive information and they are not based on providing access proactively. Further more, many laws governing ATI on high-value natural resources (*e.g*. petroleum and minerals) have substantive secrecy provisions.

In many countries, especially in Africa, Asia and the Middle East, secrecy is still pervasive in many governments and in the private sector, including around natural resources exploitation, use and management (*e.g*. fisheries, forestry, land, minerals and petroleum - Opening Government Transparency and Accountability Initiative – Opening Government http://www.transparency-initiative.org/reports/opening-government). Decision-making on development in many countries is closed because of reliance on complicated Environmental Impact Assessments (EIAs) which restrict the provision of information at the earliest phases of decision-making. No global systems exist to provide information on the quality of air and water pollution or environmental information in emergencies. Efforts to establish such systems have been stifled in many countries by: lack of government capacity to create and implement effective legal and policy frameworks; poor availability and use of technology and social media; and insufficient attention being given to building citizens capacity to engage in these processes.

Illustrative Innovative and Complimentary Initiatives

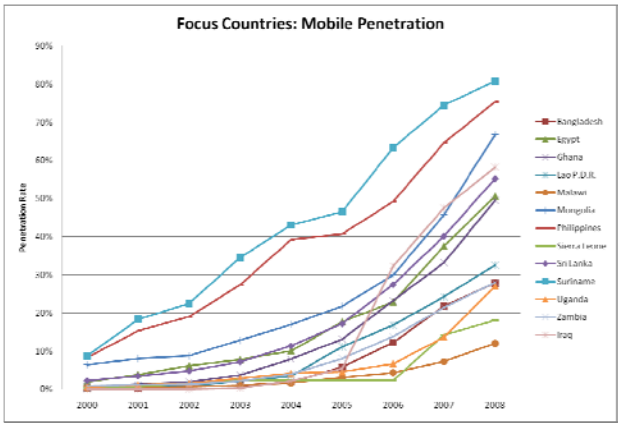
A number of ATI initiatives are being implemented around the world that constitute best practice and can serve as models for other countries. A few of these efforts are worth mentioning to highlight the range of available approaches. Additionally, initiatives that facilitate the development of data and the use of the information are noted.

- Open Data Kenya. Open Data Kenya (http://opendata.go.ke/) makes public government data accessible to the people of Kenya. It includes various types of information including information on the national census, government expenditure, parliamentary proceedings and public service locations. Information is presented in various formats, including maps, interactive charts and tables, and raw data for technical users to build their own applications and analyses.
- Open Government Partnership. OGP (http://www.opengovpartnership.org/) is a global effort to promote "more transparent, effective and accountable governments - with institutions that empower citizens and are responsive to their aspirations." Launched in September 2011, OGP works by collecting commitments from governments to promote transparency,

empower citizens, fight corruption, address transparency and harness new technologies to strengthen governance. It also provides a framework for citizens to review the performance of their governments. OGP is overseen by a steering committee of eight governments and nine civil society organizations (See http://mobiles4dev.cto.int/resources for other mobile phone initiatives).

- ChangeMatters. ChangeMatters (www.esri.com/landsat-imagery/viewer.html) is a tool that uses Landsat images to examine change over time. There are two applications that make up the ChangeMatters site. The *compare application* lets you view two years side-by-side, along with the Normalized Daily Vegetation Index (NDVI) Change between those two years. The *explore application* is a more analytical application and presents additional functionality in a single map view.
- Liberia Extractive Industries Transparency Initiative. LEITI (http://www.leiti.org.lr/) provides government-held information on petroleum, minerals, forests and other natural resources. The site supports the Act Establishing the Liberia Extractive Industries Transparency Initiative of 2009. LEITI supports the global standards for transparency in oil, gas and mining developed by the Extractive Industries Transparency Initiative (EITI) (http://eiti.org/).
- Proteus.
  Proteus (http://www.proteuspartners.org/) is a partnership between businesses and UNEP World Conservation Monitoring Centre (UNEP-WCMC) to make available global information on biodiversity. Since 2003, Proteus has compiled biodiversity data and developed tools to support businesses make better-informed decisions.

- Mobiles for Development. M4D (http://mobiles4dev.cto.int/) is a technology initiative to create practical and sustainable mobile solutions and services to enable social development by connecting them with people. M4D is a not-for-profit program, which presents a unique partnership opportunity for NGOs, government organizations, development agencies, and institutions to exploit the ubiquity of mobile phones to achieve their social goals. M4D assists organizations to increase the effectiveness of their social programs by integrating them with mobile technology. The solutions are designed with a holistic approach by integrating technology with a complete value chain system.




Stakeholders

Governments and citizens are principal ATI stakeholders. Information relevant to environmental management is generated, held and used by a large number of actors and institutions, including international institutions, government agencies, private corporations, civil society organizations and citizens. Government-held information, however, is of particular importance for citizens and civil society concerned with holding public agencies accountable and promoting sound environmental management. Governments around the world generate new information but also collect and hold information from the private sector and civil society. To promote demand for ATI regimes and increase the use and benefits of ATI mechanisms, opportunities must be established for individuals and institutions to engage in the establishment of new legal frameworks. Awareness must be raised about existing rights to ATI and the benefits of these rights. Public education, development of communities of practice and support for citizens to understand the information is important.

There has been a push by activists to develop a "citizen-centered approach" to the right of ATI that encourages governments to proactively provide the range of information that individuals need to realize their substantive rights, including their rights to a healthy environment. This has also been expressed more formally over the last five years by the open government data movement. This movement is focused on promoting the delivery of government datasets that reveal information on government services and activities without the need for a request. This includes information about "services, education and other data publicly available on the web to help improve services and contribute to future economic growth" (http://www.transparency-initiative.org/reports/open-data-study-new-technologies).

The open government data movement was first energized by the UK and the US, which pioneered the introduction of open data, but has been embraced by other governments. As of April 2010, the UK (www.data.gov.uk) listed "3,241 datasets and hosted 49 derived applications." This is part of an aspirational choice for government departments wishing to open their data to the possibilities of data mash-ups and the semantic web. In the US, by April 2010 government had created www.data.gov, which released 1,284 datasets from 170 government and related public agencies. The US System is based on an Open Government Presidential memorandum which requires federal agencies to publish new datasets annually. Most recently, in July 2011, Kenya launched an open data initiative with the goal to make core government development, demographic, statistical and expenditure data available in a useful digital format for researchers, policy makers, ICT developers and the general public (see above).

*Issues, Challenges, and Opportunities*

Effective ATI requires institutional and other infrastructure in its traditional sense. However the use of ICT, open data and other mechanisms has supported the development of more flexible frameworks for release of environmental data to the public. Mechanisms must be found to improve the quality of institutions, regulations and practices related to the right of ATI as well as to monitor and develop their achievements. Globally (The Right to Know: Environmental Information Disclosure by Government and Industry by Peter H. Sand, Institute of International Law, University of Munich http://www.inece.org/forumspublicaccess_sand.pdf), it has been suggested that challenges to tackle to provision of environmental data include:

- Systematic collection of environmental data.
- Sharing and coordination among government agencies.
- Provision of data in easily understandable formats to the public.
- Appropriate legal frameworks for the provision of environmental information.
- Widespread use of existing legislation and mechanisms.
- Implementation and enforcement of information systems.
- Political will to continue to address secrecy in the more developed systems.
- Knowledge and capacity in the most vulnerable groups.

ATI is a prerequisite for accountability, but transparency alone cannot guarantee responsive government and sound environmental management. Accountability is frequently described as an account-giving relationship between individuals. It requires information, especially information on performance, as well as the power to guide and discipline the behaviour of responsible actors and institutions. Of particular importance is the role of citizens and civil society in overseeing government, including the executive, legislative and judiciary branches of central and local government. ATI coupled with citizen activism and civil society advocacy can achieve accountability on environmental matters. Increasing government capacity and strengthening administrative practices to respond to citizen requests and make information proactively available will support the right of ATI. Building demand in government and civil society is critical to

understanding and recognizing the importance of a universal right of ATI. Finally, it is important to systematically address secrecy of governments and multi-national companies to have long-term gains in the provision of environmental information.

*Crosscutting Issues*

This issue has relevance to Working Group 1 looking at Policy and Governance. It was identified that here is a lack of discrete policies that dictate specific rights for access to government information by the public in certain countries. It is suggested that on Day 3 of the "Summit" a combined Working Group 1 and 2 discussions be held to debate the importance of countries adopting ATI legislation.

### 2.3.9 Provide Effective Surveillance and Early Warning

*Setting the Foundation*

There is no comprehensive surveillance and early warning capacity for the environment. The need for such a capacity is clear. Environmental pressures are increasing to unprecedented levels, in many cases at escalating rates; many Earth systems are now operating outside of historic bounds and globalization is facilitating complex linkages across long distances. As a result, environmental problems and crises are emerging in ways that take local and global actors by surprise and outstrip the ability to respond effectively. Rapid deforestation, overfishing, industrial contamination, pollution from extractive industry operation, severe soil erosion, invasive species, water scarcity problems, water sanitation breakdowns, spikes in illegal hunting or logging, are all examples of environmental problems that would benefit significantly from more sustained and comprehensive surveillance and early warning.

In general, environmental information systems are very slow and as such have traditionally had very little use as early warning systems. In many cases, they also have limitations around the data they hold, much of which is either a one-off snapshot in time at scales that are inappropriate for predictive modelling.

Surveillance is a very costly process and data needs to be captured constantly. However, the trade-off for this expense is that by undertaking extensive surveillance, a long time series of data are being captured, which when fed into the appropriate predictive models, improves the forecasting capabilities of early warning systems.

Relevant stakeholders include the following:

- Policy communities operating surveillance and early warning systems across other sectors, which would benefit from environmental surveillance. Examples include public health, natural disaster management, humanitarian crisis management and food security organisations.

- Global Pulse, an initiative of the Secretary General was designed to provide near real-time information relevant to global hotspots.
- Policy communities working on crises or in regions where vulnerability to environmental problems is very high, for example peace building, poverty reduction, human security.
- Corporate social responsibility communities wanting to monitor potential environmental hotspots relevant to corporate activity.
- Applied science researchers and policy makers concerned about emerging crises would benefit from a comprehensive ability to monitor the timing and location of emerging problems.

*Alignment, Opportunities and Constraints*

Building a comprehensive surveillance and early warning system will be costly, time-consuming, and politically sensitive. However, there are some simple "quick wins" that would be relatively straightforward to implement and be welcomed by many actors. For example, a growing number of policy communities are interested in droughts, yet there is no systemic information system to generate surveillance and early warning. A mechanism that consolidated drought information, using a range of data flows; and integrated it with socioeconomic information relevant to vulnerability; provided a wide range of stakeholders would use relevant forecast information; to monitored potential impacts. Another potential quick win could come from integration of disparate surveillance and early warning systems in way that made possible better identification of patterns, perhaps for example regarding trade in endangered species.

*Way Forward*

There are a number of steps needed in order to build an effective environmental surveillance and early warning system, these include:

- Ensure there is a political understanding of the need for such a system.
- Where there are cross boarder issues, ensure the relevant multilateral agreements and commitments are in place.
- Identify the relevant indicators to be monitored.
- Identify the relevant scale to monitor at.
- Implement the minimum required number of monitoring stations.
- Identify or build the relevant forecasting models.
- Invest in the relevant computing and communications systems.
- Set in place the relevant mitigation processes should an environmental disaster be predicted.

*Crosscutting Issues*

The implementation of implementing an Environmental Surveillance and Early Warning System has obvious user needs and content requirements, but there are important linkages to the other WGs.

The political will and governance needs to be in place in order for such systems to be developed, they are costly so a clear need for them needs to be demonstrated and understood (WG1).

The technology needed to drive these systems is becoming more and more sophisticated with the increasing need for real time monitoring and high-speed communication (WG3).

The human resource will be the component of these systems that will ultimately "make or break" the system, it is therefore vital that there is a strong human capacity building programme linked with any Environmental Surveillance and Early Warning System (WG4).

## 2.4 The "Take-away" Message for the Future of EIS

Four user needs and content initiatives the international community can invest in right now to start meeting the challenges of future EIS requirements are:

**Digitising legacy data** – there are large volumes of data in paper formats, these data would greatly add to the time series dimension of environmental information, possible filling some of the gaps in the data.

**Integration/capture of traditional knowledge** – In many traditional cultures the accumulated knowledge and wisdom of the culture are increasingly "locked up" in the aged generation. This information is invaluable and needs to be captured before it is lost.

**Formalising rights of access to information** – Many African and Middle Eastern countries do not have legislated rights of citizens to access government information. This is believed to be a fundamental right of the citizen in order to encourage transparent government.

**Major data collection exercise** – A process of identifying what "fundamental" environmental information sets are needed by a government to ensure that the monitoring of key environmental necessities are met. Then a process of systematic acquisition of these data should be set in motion.

*Crosscutting issues*

Setting up a harmonization process, as well as the actual integration of databases are mostly technical issues, fitting with WG3 - Technical Infrastructure.

Fitting with WG3 – Technical Infrastructure. The need to ensure that metadata are produced to assist in the discovery and integration of Environmental Information.

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