

# **Integrated Web based Information on Freshwater Resources**

## **The Water Resources & Wetlands e-Atlas**

**WetWorld design team\***

### **Executive Summary**

The fragmented and inaccessible character of current freshwater information hinders the participation of many stakeholders in water management. The Water Resources and Wetlands e-Atlas - project is designed to fill this gap in web-based data and information management. A range of key partners provides access to their data through a customised interfaces that allows integrated access, analysis and visualisation. The e-Atlas will go beyond available portals in the integration of various on-line databases and the customised and targeted presentation of information. Users may query data on freshwater ecosystem management, for instance on river flows or wetlands, and the results will be presented in customisable maps and figures. The e-Atlas will inform user-groups and stakeholders on water management issues; support knowledge development, policy design and decision-making; and empower people to participate in water resources management dialogues. A set of tools to present data in convincing and revealing maps and figures will improve the dissemination of information and the awareness on freshwater issues of a wider audience. In short, the e-Atlas links relevant data, institutions and expertise, integrates different sets of data from the global to the basin level and provides an interactive communication platform empowering stakeholders from regional to global levels.

### **Introduction**

Data and information become increasingly important in freshwater issues. Good policy design, research, monitoring and participation always involve sufficient and reliable data to be available. However, even though much data are available, access to these sources is

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a problem. Data are stored somewhere obscured from sight for the people that may be in need of that information. The available data, for instance through the internet, are usually sectoral and there are great difficulties when one wishes to combine two or more datasets.

But the problems in integrated water management are usually multisectoral problems, that are very much reliant on data from different sources to be available. Integrated basin management can only be achieved when we look at sanitation, biodiversity, socioeconomics to name but a few. The complex interrelationships of the issues involves requires a solid and diverse information base.

The need for information and especially the need for improved dissemination of information have resulted in numerous initiatives to make data available through the internet. Maps and data can be found on specific issues, yet the usability of these can be questioned. More often than not, data are presented in simple table forms or in downloadable files which leads one to suspect they only intend to reach a professional audience. Maps and figures provide basic data to an expert audience, but usually do not address the multisectoral complexity of basins or more complex questions from the audience. An interface that allows combination of data and more complex online interactions, which would allow more targeted data access, does not yet exist.

This paper proposes such an interface, the Water Resources & Wetlands Atlas. In this paper, we will first examine some of the available data on the internet and specify current shortcomings. It will go on to describe the e-Atlas, its concept, audience and goals and the process through which we want to establish it. The discussion will address some of the major traps anticipated, as well as the mechanisms through which they can avoided. This paper aims to demonstrate the necessity for and feasibility of this project as well as inspire the reader in her or his way to contribute to improved information in integrated water management in general and, hopefully, to the e-Atlas in particular.

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## Data

There are many different datasets on freshwater resources from different organisations. For instance, FAO's Aquastat provides data on water resources, irrigation and land use. IWMI has recently developed the World Water & Climate Atlas, which provides data on the world's meteorology and water uses. Table 1 contains some examples of databases related to freshwater resources with a short description of their content. Even though these examples and other initiatives like them are valuable, we can see the usually sectoral character of data collection and dissemination. The data are collected and made available for a specific use, for instance to monitor water availability for irrigation, not for a more integrative approach that takes into account other sectors and data.

Table 1 *Examples of data available on the internet on freshwater resources*

<b>FAO Aquastat</b>	water resources, irrigation and land use, tables and defined maps, fish catch maps
<b>WRI Facts &amp; Figures</b>	Defined maps, tables, summaries on water resources, economics, biodiversity etc.
<b>IWMI World Water &amp; Climate Atlas</b>	Precipitation, water and land use, downloadable datasets
<b>UNH</b>	IAHS (metadatabase), Global Water Resource Assessment, Global river discharge, defined maps
<b>FRIEND</b>	Flow regimes and analysis in hydrology, maps
<b>WRI</b>	Critical flows, fragmentation analysis, nutrient net, ecosystem assessment, online summaries and maps
<b>IAHS</b>	Global water databases metadata system
<b>European Basin Network</b>	Research basin inventory
<b>Global Runoff Data Centre</b>	global river discharge data, downloadable data, global maps on themes

A second problem with existing data, even though the data may be very suited for application to specific sectoral issues, is that of compatibility. The combination of two datasets, even when available, is often problematic. Such integration may however greatly enhance the data's usefulness and wider applicability. A well-known problem is the difference in scale that makes combinations very difficult or limits the usability of the

available information sources to a qualified and specialised audience. Unreliable information and the limited access to sometimes valuable data further confound the problem of sectoral and fragmented data.

We need not elaborate too much on the problems with freshwater data. The fact is that information on our freshwater resources is sorely lacking, which has been noted at several occasions (i.e. recently at the 2<sup>nd</sup> World Water Forum) and by many people: the lack of access to reliable information is a factor seriously hampering integrated water management. Nonetheless, there is a large amount of data already available for an information base that supports integrated water management. The main question is how to integrate that data and make it accessible to a wider audience.

### **Developments in water management and the internet**

There are several specific developments that put this question ever more prominently on the forefront. Without claiming exhaustiveness, we want to highlight some which induced the concept of the e-Atlas. The first trend can be witnessed in integrated water resources management. There is an increasing pressure to make management of our water resources participatory, to allow stakeholders to participate in decision making on basin management. Such participation can only be realised if those stakeholders have access to information on their freshwater resources. Access to information becomes vital when we want to establish basin-wide authorities, regional coordination and increased collaboration within basins.

A second development is the use of the internet itself. More and more people become connected and, perhaps more a hope than established truth, developing countries may see a similar expansion. As the internet becomes a valuable source of information for a variety of users, the focus of all communications becomes the information need of those users. Users with specific information needs are most interested in finding an answer to that question, less to the organisation that answers it. People submit specific questions to search engines in the sometimes vain expectation that the answer will present itself at the top of the list.

This does not mean to imply that the organisation does not matter anymore. Naturally, the organisation sometimes (if known to the user) provides valuable clues on the reliability of the information. Stock quotes will be found more reliable when they come from the stock exchange, than from an obscure investment firm. But the focus is on specific information related to specific questions, and this implies an ordering of information on the internet not by organisation, but by topic.

Finally, there are advances made in web technology, data management and GIS that lead to new experiments and websites every day. It suffices to say that Java, MapObjects and other new client-side applications make the online manipulation of data and images increasingly possible.

### **Water Resources & Wetlands e-atlas**

The above has induced the development of the Water Resources & Wetlands e-Atlas, or the WetWorld project as we have (for now) baptised it. Below we will briefly examine its concept, its aims, its tools and its future development.

#### **The e-Atlas concept**

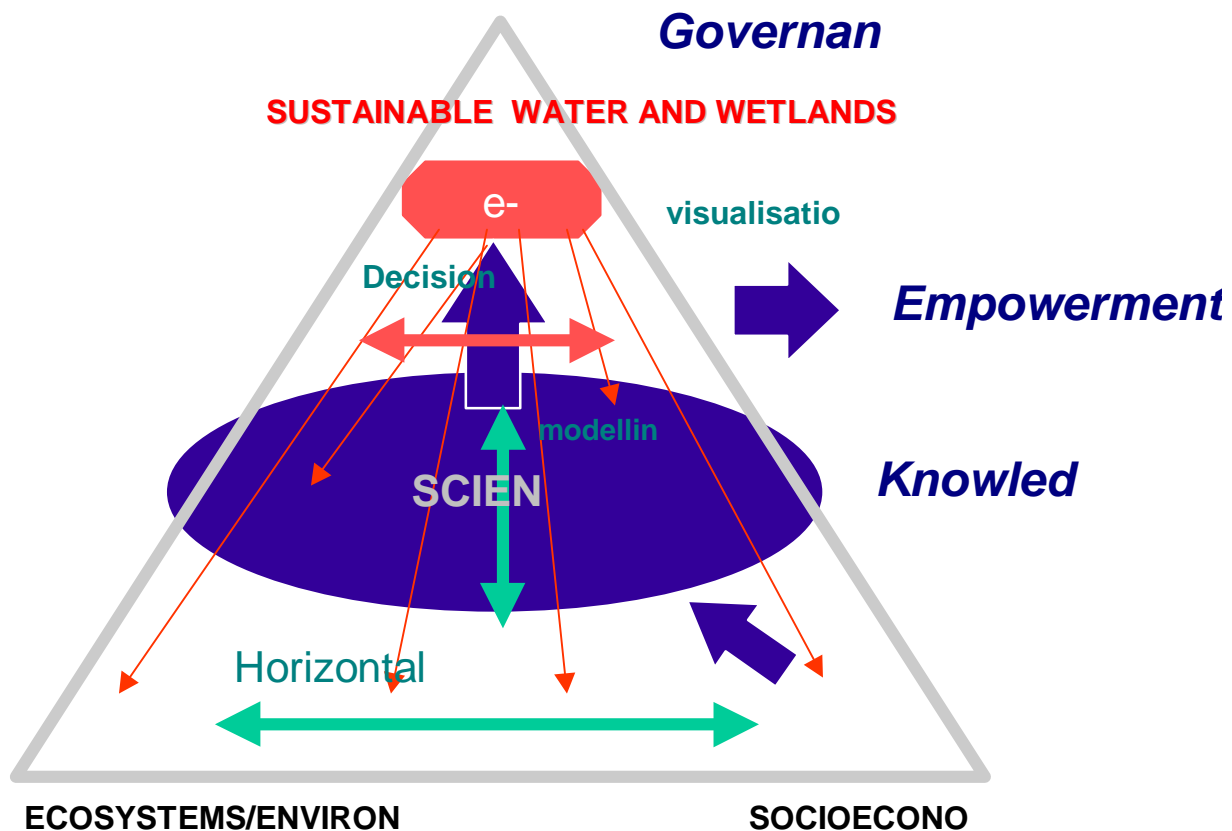
An atlas in general denotes a collection of maps in book form. You take it in your hands and you look at the world. However, on a different level an atlas is also a way of ordering and integrating information and putting it in a presentable form. Many people have gathered information on geographical or economic features and experts have turned the complexity of information into a colourful map on paper. These are the key elements in the Water Resources & Wetlands e-Atlas: the ordering and integration of information and the presentation of that information in a clear and accessible manner.

The e-Atlas intends to be a web-based, interactive data and information access and management tool for water resources and wetlands. As such, there is a first level on which the e-Atlas will function, and that is as a Vortal. An index of available data sources

can guide users to the appropriate information and bring different parties working on water together. A meta-database is therefore one of the essential parts of the e-Atlas.

But we want the e-Atlas to go beyond that point and not merely index the data available, but seek for ways to integrate that data. The e-Atlas should combine different existing data and information sources to produce standard and customisable data products on water resources and wetlands. The first part of this challenge is a technical question: how can we achieve the integration of the many different data there are on the web and elsewhere today ? The second part of this is a question of communications: how do we allow users to access the information in a presentable and interactive form, so that the e-Atlas may indeed meet their information needs. Then finally, this is a question of organisation. Data are a valuable resource and the question is how we can set up an organisational structure that will stimulate organisations to participate in this endeavour by contributing data and knowledge in whatever shape or form. We will further elaborate on these issues further below.

Figure 1 contains some of the main characteristics of the Atlas. Data come from both



ecosystem sciences and socio-economic sciences, and is collected on a diversity of subjects. As we move upward through the pyramid we cross through the scientific data and models that are available today and come to a layer where information from different sources is used to make informed decisions and to communicate. It is at the top of this pyramid the atlas is positioned, between the science-oriented information and the difference users of information, and is not designed to collect data or develop scientific models. Naturally, in the long run the e-Atlas may guide data collection as information gaps become visible, but primarily the e-Atlas brings together the information available (which can be data, models or expert opinions) and then communicates that information to empower and inform.

### **Goals and audiences of the e-Atlas**

The e-Atlas has three major target audiences:

- Policy makers
- Researchers
- NGOs and communities

All three of these groups have a very distinct information need. Policy makers have a need for information to support their decision-making and management activities. Researchers need information for their assessments and analyses and of course an idea of where research priorities are. Finally, and maybe the most important as well as most diffuse group, NGOs and community groups require information to participate in water dialogues, either at the local or regional level.

The aim of the e-Atlas is to cater for all three these groups, but in saying so there is also the realisation that this is very ambitious. The more specific objective of the project is to enable wider access to water resources and wetlands data, information and knowledge through developing a web-based information management system, the Water Resources and Wetlands Atlas.:

- to inform user-groups and stakeholders on water management issues;
- to support knowledge development, policy design and decision making;

- to empower people to participate in water resources management dialogues.

### **Questions and answers**

To achieve these goals, data, information and knowledge is needed on three distinct levels. The first is on facts, information that on certain subjects is already hard to find. We may think of questions such as where are dams being planned and built, or where are biodiversity hotspots located. But it may also be in the shape of managing a network and answering questions such as which hydrologist in my country or region might help me develop a model ? The second is on analysis, to examine the relationships and causes of some of the facts. We may then think of questions such as what has been the increase of irrigated lands in the last decade, or can we say on the relationship between population growth and freshwater quality ? In these questions the factor time plays an important role, when we look back to see what caused some of the phenomenon we see today. If we take this further, we come to the third level which is the level of scenarios. In scenarios we extend our experience to the future, with questions such as how might encroachment to Lake Chad develop in the coming five years, or what will be the effect of climate change on wetland ecosystems ?

Several institutions hold the data to partly answer these questions, yet there may be large gaps in our knowledge. For instance, there may be no data on fish catches in the Mekong Delta or of population growth in Central America. The e-Atlas could, in the long run, help us identify these major knowledge gaps and assist institutions and individuals to specifically fill these gaps.

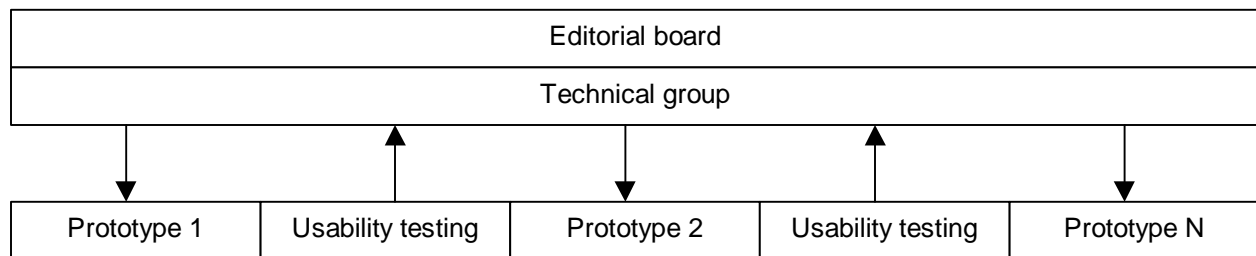
### **Presentation and interactivity**

Current online data suffers sometimes from lack of presentation. We are all too familiar with tables filled with data which hardly convey the crucial messages sometimes contained in them. This is clearly a question of communication: if we want to disseminate information or empower people to participate in water discussions, how can we present information in an accessible form ? The second pillar of the Atlas, besides the

management and integration of information, will therefore be the presentation of these data.

It is important to here recall the target groups, which may have different information needs. Researchers may be interested to manipulate data themselves, and might be more interested in downloading certain data files. Global policy makers may be more interested in a map showing locations where rivers have been altered. The first lessons we can draw from this that in the development of the e-Atlas, at different stages and in different ways the intended end-users will be asked for their feedback on prototypes (figure 2). The second lesson is that the system should offer the flexibility to manipulate the data online as well as manipulate the way these data is presented.

Figure 2 *User testing and prototyping of the e-Atlas*



The results of this focus on presentation can perhaps be seen at several online sites, such as hydronet of UNH. This website contains maps, users can zoom in and download data. [examples of websites where data can be downloaded and manipulated, epa wetlands site, search engines etc.] Global maps, zoom in to basins / search engines / topical entrances ?

Finally, contrary to what the name may suggest, the e-Atlas need not all be high tech and internet based. Given that a large part of the audience is in areas of the world where internet access even when available can hardly be called reliable, the e-Atlas will establish a communication strategy which will also entail access to the database through other means. Distribution of data and results can also be achieved through CD-ROMs and it may be even necessary to use paper printouts of these to send to remote users. Then,

users do not have to put their queries to the database online, but can also use the CD-ROM or simply call the team working on the atlas with their questions.

### **The e-Atlas in brief**

Summarising the above, the e-Atlas:

- Links relevant data, institutions and experts
- Integrates different sets of data from the global to the basin level
- Communicates through easily accessible interactive and convincing maps and figures

In order to:

- Inform user groups on water management issues
- Support knowledge development, policy design and decision making
- Empower people to participate in water resources management

### **The organisation of the e-Atlas**

The atlas depends largely on managing a network. To manage this network, a preliminary editorial board has been set up that will guide the development of the e-Atlas. The initial partners are now working together on the first phase, which explores the idea further and will demonstrate the feasibility of the project.

An important part of this effort is finding out what already does exist in the field of data and information. Firstly, a meta-database of existing datasets is in development. It builds on the work already done in this field by for instance UNH (IAHS) and will provide an overview of the data available. Secondly, we are exploring diverse datasets and the local activities of the partners on the basin level to select two basins for which data is or will be soon available. Thirdly, an inventory of existing (scientific) models will be made, which will for instance include the work done by RIVM on modelling the effects of climate change.

The editorial board has selected three issues which will serve as case studies for which these data will be used:

1. The conflict between irrigation and nature conservation
2. Climate change
3. Interbasin conflicts (e.g. upper vs. lower watershed)

The editorial board has defined these general issues as important, but will, through its network, examine the concrete policy questions that exist and that the e-Atlas products should answer. The fourth element is therefore an inventory of existing policy questions related to these issues and the fifth is to merge the above into a prototype of the interface. The interface will combine the three concrete products with a more general idea of what the e-Atlas should be.

A large part of the effort will go into developing a business plan, which will focus on the long term. The e-Atlas is not intended as a project for a few months, but should provide information over a much longer term, if not be a permanent effort. This demands a clear long-term funding strategy as well as a clear strategy to establish a network of collaborating centres of excellence as well as to maintain it. The intention is to establish a network of collaborative centres or data groups who will on a regional or topical level work together to focus on data collection and manipulation.

This network will not only include specific water-oriented institutions and experts, but will also include private companies, such as publishers and software firms. Publishers have the knowledge to disseminate information whereas software firms can provide useful knowledge on data management or computer technology in general. We truly hope this project can bring together different parties under one flag, wherein each provides specific strengths and expertise.

With the business plan as the sixth element in the agreed course of action, the editorial board will reconvene early next year to discuss progress and set the next steps.

## **Conclusions and discussions**

The e-Atlas is a promising project. There was a first meeting with representatives from a number of institutions with a strong track record in water resources and information management that has led to an initial commitment. The brainstorm during that session brought forward interesting ideas and an action plan for the coming months.

There is a strong need for more global and regional data and information on freshwater resources from policy makers, researchers and NGOs alike. Through the developments in information technology, most notably the internet and cd-rom, we have the means to link the various sources of information and disseminate it widely. Along with the growing intention for our natural resources, the time seems therefore right for a project as the WRW-Atlas.

To make a working Atlas, there are some obstacles to overcome. The first one is to have the data. Will the concept be strong enough for people and organisations around the world to share the information they have ? The reactions of the initial group are encouraging, but we are not there yet. Then there is the question whether integration between data can be achieved without losing meaning, i.e. to find a balance between compatibility and accuracy. Finally, the most important question, if the atlas can provide people worldwide with the information they seek and use in their daily work. To make the chance as high as possible the project will involve end-users and stakeholders in every step.

The coming months will see the development of three examples. These are a first step towards developing the e-Atlas and will answer some of the main questions now surrounding the project, mainly on the level of data. The business plan then is used to establish wider collaborations with centres of excellence to put in place the network of expertise on which the e-Atlas will be so dependent. The goals of the e-Atlas are widely shared within the water management community, and this project will contribute to forging that willingness into concrete products and ultimately contribute to improved policy and practice in integrated water resources management.