Water management indicators - State of the art for the Mediterranean Region

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Water Management Indicators - State of the Art for the Mediterranean Region

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Abstract: In the Mediterranean region physical water scarcity is an important issue, and consequently the management of water resources is of great relevance, in order to achieve sustainable development. However, big challenges in water management and the perception that current water management models do have deficits in integrating the views of important key stakeholders have increased the (especially international) pressure for implementing actions towards Integrated Water Resources Management (IWRM). As a consequence, an increasing interest in water resource assessment and water management indicators can be observed. This paper discusses existing water management indicators sets - SWAP, Aquastress Water Stress Index and UN Water – Water monitoring - with respect to their applicability in the Mediterranean region. For this purpose, the authors' perceptions were complemented with the knowledge of a group of experts which contributed by means of expert interviews. The main conclusion of the analysis is that so far no indicator set tailored for the Mediterranean has been developed. To develop the best-suited set a participatory, integrative and iterative process needs to be set up. The present paper constitutes the first iteration step in this process.

Key words: Water management – Indicator – Policies – Water availability – Water use

Les indicateurs dans la gestion de l'eau – État des connaissances pour la région de la Méditerranée

Dans la région de la Méditerranée, la raréfaction des ressources physiques en eau constitue un problème particulièrement important. Les grands défis qui s'offrent à la gestion de l'eau et la prise de conscience accrue que les modèles actuels de gestion de l'eau intègrent insuffisamment les points de vue de parties prenantes importantes ont récemment accentué la pression (en particulier internationale) pour la mise en œuvre de mesures favorisant une gestion intégrée de l'eau. On observe en conséquence un intérêt croissant pour l'évaluation des ressources en eau et pour les indicateurs dans la gestion de l'eau. Des interviews avec des experts de premier plan et une analyse bibliographique étendue permettent de comprendre les difficultés liées au développement d'ensembles d'indicateurs adaptés à la Méditerranée. Trois ensembles d'indicateurs de grande valeur sont examinés plus en détail : SWAP, Aquastress Water Stress Index et ONU Eau – Surveillance de l'eau. Ces ensembles d'indicateurs ont été analysés avec deux experts qui, chacun, mettent en avant des éléments différents du développement d'indicateurs. Nous pouvons conclure qu'il n'existe pas à l'heure actuelle d'ensemble d'indicateurs idéal. Le développement d'un ensemble d'indicateurs parfaitement adapté nécessite la mise en place d'un processus participatif, intégrateur et itératif. Ce document constitue la première étape de ce processus.

Mots clés: *Gestion des eaux – Indicateur – Politique – Eau disponible – Utilisation de l'eau*

I – Shaping the aim

The purpose of the present paper is to compare existing approaches of water resources management which use indicators for the performance of an economic system, a country, a region, etc. and to identify or propose respectively a set of indicators best suited for the application in the Mediterranean region and to be elaborated throughout the MELIA project. Therefore, it appears useful to first try to define what exactly 'good', 'sustainable', or 'desirable' water resources management looks like. The following definition is certainly only an attempt as well as a basis for discussion. It shall serve to shape the frame that should be filled by the indicators to be chosen. An extensive literature review was performed. The detailed report can be found on the Melia website (http://www.meliaproject.eu/).

Sustainable water resources management consists of local and regional practices as well as political frameworks and directives steering these practices, which ensure that the actual requirements for drinking water, irrigation water, water for industrial use, as well as for the continuity of biotopes are fulfilled without constraining reaching the very same objective in the short-term, medium-term or long-term future. It is based on responsible, effective, as well as efficient water consumption, strongly related to traditional local knowledge and techniques, as well as modern technologies and political approaches targeted at different scales of time and space.

II – Introduction

Definitely: Water is one of the key issues of sustainable development. It is one of the basic elements for human survival and human well-being; it is an important production factor within the economies of societies and it is a habitat of biodiversity. Clearly: there is a social, an economic and an environmental dimension to the sustainability of water. Each dimension does have impacts on each other dimension, and these impacts do differ and change over time and depending on the scale.

In the Mediterranean region, where physical water scarcity is an important issue, the management of water resources is of great importance, in order to achieve sustainable development. However, big challenges in water management and the perception that current water management models do have deficits in integrating the views of important key stakeholders have increased the (especially international) pressure for implementing actions toward so-called 'Integrated Water Management'. Consequently, linked to the agreement on the Millennium Development Goals (MDG; http://www.undp.org/mdg/), an increasing interest in water resource assessment and water management indicators can be observed.

Beside the fact that a considerable number of water scarcity indicators already exists for the assessment of the level of water shortage in the different parts of the Mediterranean, they presently suffer from serious flaws. Related to this, in the technical annex of the MELIA project states the following:

First of all, they are limited to 'blue' water only, neglecting the important contribution that 'green' water makes to global food production.[1] *Secondly they are based on averages and hence hide the very important temporal and spatial variations of the water resources which are often the determining factors for water scarcity. They do not consider climatic differences, differences between primary and secondary uses or the effect of life-styles and citizens' perception. Much has to be said also to include the needs of essential ecosystems in the primary needs, as has been done implicitly in the new South African Water Act, where basic human needs and the needs of the environment are given priority above the other issues. Also water policies need to be formulated and assessed in relation to their level of adequate 'integration' with sustainability as well headline indicators (sector physical and non-physical indicators). This assessment is possible on the base of selected common indicators used to assess the process of integration of policies ('integration' indicators).*

The purpose of the present paper is to suggest a relevant indicator framework for water scarcity and management for the Mediterranean region. The framework will build on existing indicators sets which ideally consist of indicators which are simple, easy to understand, easy to measure, representative, well linked to social, economic and physical dimensions and to be used for a future benchmarking exercise. Furthermore, in order to ensure a high-level assessment of the state of the art in the area of water management indicators, we decided to complement our own perceptions with the knowledge of a group of experts which contributed by means of expert interviews. The experts to be interviewed were chosen in a way that the expertise of Mediterranean neighbours from the three different continents adjacent to the Mediterranean Sea would be represented. The experts interviewed are:

- Suhita Osório-Peters, CEIFA ambiente – Portugal

- Dr. Alaa El-Din Abdin, Ministry of Water Resources and Irrigation, Strategic Research Unit – MWRI – Egypt
- Basim Ahmad Dudeen, Land Research Centre – LRC – Palestine

The interviewees answered a set of questions prepared by the authors. The information gathered by that means was directly integrated (and where appropriate cited) in the paper. In the following the questions are listed:

- What is the role the resource 'water' plays in the Mediterranean?
- What are the main issues to be tackled to ensure sustainable water supply for all people throughout time in the Mediterranean?
- What are the main areas of interest with relation to water management in the Mediterranean?
- Three existing sets of indicators are described in chapter 9. Please comment on their appropriateness for the application in the Mediterranean. Do they reflect the identified areas? Would you suggest others?
- Is it feasible to gather this kind of data? How would you appraise the situation in your country/ region in terms of data availability/quality?
- Who should take over the responsibility for data collection/creation responsibility?
- In how far can measurement results influence/have an impact on politics?

III – The role of the resource 'water' in the Mediterranean

In the Mediterranean, water resources are limited, fragile and very unevenly distributed over space and time. During the second half of the 20th century, water demand has increased twofold, reaching 280 km^3/year in all riparian countries in 2005. The number of people living in water scarce countries, with less than 1000 m^3/capita*year, reaches 180 million inhabitants, 60 million of whom face shortage conditions with less than 500 m^3/capita*year. Twenty million Mediterranean people are deprived of access to drinking water, particularly in the South and East. Water supply in several Mediterranean countries is endangered by the over-exploitation of a part of the renewable groundwater (Blue Plan; Benoit and Comeau, 2005).

Water can be seen as a vital resource; the key supporter for the development in the Mediterranean. As such it is essential for the improvement of people's quality of life. However, in the Mediterranean area 'water' is not only a life-supporting resource (domestic use), but also a very important production factor for the most relevant economic sectors: agriculture, agro-industries (food and beverages), tourism, pulp and paper production, etc. For instance, according to the 'National Water Plan', agriculture uses yearly 75 % of the total water consumption in Portugal, while energy production represents 14 % and the industry sector 4,4% (expert interview Suhita Osório-Peters).

Due to its social and economic relevance, governments have always had problems with imposing water prices. Agriculture remains a crucial issue, because it is a basic production sector, providing employment to many people in these regions, but it is also the sector that uses the largest quantity of water and requests water with minimal quality standards. Any quantitative or qualitative limitations on water supply can have dramatic consequences for the population. Due to climate change, the availability of water will probably decrease in the next decades and the strong seasonal variability of precipitation has strong impacts on soil quality, risk of erosion, draughts and flood. Water management must have a greater influence on land use planning in all countries in Southern Europe. Large projects of water transfer and dams are being built in many regions, but the long-term impacts of those interventions may be catastrophic (expert interview Suhita Osório-Peters).

IV – Ensuring sustainable water supply in the Mediterranean

The focus of the MELIA project is to establish a Mediterranean dialogue on integrated water management. The term 'integrated' is essential in this context, as it implies that the solution of the management problem cannot be found through a technocratic approach only, with top-down planned and implemented improved infrastructure, but needs to be multi-layered in terms of the theoretical approach as well as the incorporative (participatory) planning and implementation. Hence, the issues to be tackled to ensure sustainable water supply for all people throughout time in the Mediterranean can be divided into rather general and political issues and the technical issues necessary for a functioning supply.

In the course of the expert interviews, Basim Ahmad Dudeen emphasised that the question of water management is a political process of the first degree. The political/management issues were identified by the experts Suhita Osório-Peters and Basim Ahmad Dudeen as (with a contribution by Alaa El-Din Abdin):

- To assure the health and well-being of humankind the priorities for water use should be set at the national level and the international (WHO) standards on designated water allocation per capita adopted.
- The reallocation of water use for the benefit of the national economy, taking in consideration environmental preservation, should be prioritized.
- The agricultural economy is an area that should be addressed thoroughly to enable rationalization of water use. For example, the concept of virtual water should be taken in consideration.
- Raising awareness and education. Every person should feel responsible for efficient water management; it must be seen – like municipal waste management – as a collective task of citizenship.
- Change the current regional development paradigms, which do not regard water as an actually limiting and vital resource for sustainability. For example, it is not sustainable to give priority to golf courses in these regions, in order to develop tourism. Reuse of waste water should be developed.
- Water prices can stimulate efficient water management.
- Water bodies often cross land frontiers. A better cooperation between countries that share rivers, lakes and groundwater reservoirs is needed.

On the other hand, the technical issues are as follows (expert interview Alaa El-Din Abdin; Suhita Osório-Peters)

- water management improvement for infrastructures of water supply
- higher efficiency for supply networks
- minimise water losses
- improve technical capacity for water supply and management engineers
- reduce water demand through O & M utilising the best technology
- technological innovation leading to reduced water use can contribute to important water savings; RTD incentives can be used to spread best distribution and irrigation techniques.

V – Complexity of water resource management

'Inherent complexity' of water management as the main challenge

Assessing water resources and their management faces several difficulties (see Faures, 1996). First, *the type of water resource to be measured has to be defined*. In Mediterranean countries, the part of non-renewable water resources (water available from aquifers with a negligible rate of recharge) which is used for water supply can represent a significant share in the total volume; sometimes bigger than the share of renewable water resources. This is very critical especially from a sustainability point of view. Additionally, 'green water' represents an important part of the available water in arid countries. Another important source for irrigation is re-used wastewater and desalinated water. Therefore, water resources assessment simply on the basis of 'blue' water is of little use for planning purposes. Moreover, one must not forget wastewater, its treatment and the consequences for freshwater bodies.

A second difficulty arises from the *spatial variability of surface water and groundwater (see Faures, 1996)*. Both resources are usually computed separately although they are part of the same water cycle. Separate computation of surface water and groundwater usually leads to an over-estimate of the total amount of available water resources in a given area; an error frequently observed - even in specific water resources studies. Directly related to this issue is the problem of geographical boundaries used in assessing water resources. In order to maintain the integrity of the water cycle, surface water has to be computed on the basis of river basins, while groundwater has to be assessed on the basis of groundwater bodies (aquifers). These basins rarely have the same geographical extent, especially in arid countries, and they almost never correspond with political boundaries.

Although water resources are usually accounted for on an annual basis, and compared with yearly demand, large *seasonal/temporal variations* can be observed which can substantially reduce the amount of water actually available for use. In countries where agriculture heavily relies on water resources during the dry season, water availability may be significantly reduced if no storage capacity is available for regulation of wet-season flow.

Spatial as well as temporal variability are strongly related to the respective local climatic conditions. Therefore, regional approaches to water management have to take account of differences between specific countries, as the climate may affect countries in different ways and at different times.

With regard to the above mentioned challenges, an important issue is the question of *data availability and quality* respectively, as without comprehensive data of decent quality these questions will be difficult to be answered. Here the important question to be asked is which authority shall be responsible for the collection of these data. Suhita Osório-Peters explained that data availability about water is a very difficult issue in Portugal (and this situation may serve as representative for other Mediterranean countries). For example, traditionally, people consider groundwater on their land as their own property; thus, they do not accept government control over the wells they have on their land. Consequently, although legislation has changed, the implementation of the new water laws remains a very difficult issue.

A further complication lies in the concept of *'availability' of water (see Faures, 1996)*. River runoff, for instance, is not fully available due to seasonal variations and the occurrence of floods. Additionally, part of the water flowing into a neighbouring country may be reserved by treaty or agreement and thus cannot be considered as available for use in the upstream country. On the other hand, the water use (and pollution) of upstream countries can have serious implications on the availability in the downstream country. The availability of groundwater is subject to the country's capacity to extract the water. In summary, the concept of availability, which is much more powerful than that of water resources, can hardly be applied systematically over all countries and

has strong economic and political implications. Most of the limitations described above apply with a much higher intensity in regions where water is scarce, which at the same time are those regions where water resources present a limitation to development.

Certainly a very important issue is the question of *life style and the perception of water scarcity problems* by the local or regional population, as people may not be aware of the consequences of their own life style for the local or regional water situation. Consequently, in such an environment a need arises for good and considerate governance and education which aims at 'steering the public opinion' into the right direction.

Additionally, a very important aspect is the integration of all relevant stakeholders in the discussion about distributing available water resources. Here, it is essential to provide also the 'speechless' with a voice in the discussion process, e.g. when it comes to defending water requirements for the purpose of preserving ecosystems and their values and functions; but also with respect to stakeholder groups with weaker political representation.

VI – Indicators for water resources management

To use indicators for measuring and demonstrating a part of reality in a simplified manner is not a new concept. It has become especially popular as a tool for assessing progress with sustainable development objectives (Spangenberg and Bonniot, 1998).

In 1987 the World Commission on Environment and Development (Brundtland Commission) called for the development of new ways to measure and assess progress towards sustainable development. Consequently, in 1996 an international group of measurement practitioners and researchers from five continents got together at the Rockefeller Foundation's Study and Conference Centre in Bellagio to develop principles for the elaboration of indicators for sustainable development, the so-called 'Bellagio Principles'.

The four main aspects of assessing progress towards sustainable development are the following:

- Starting point of any assessment - establishing a vision of sustainable development and clear goals
- Content of assessment and the need to merge the sense of the overall system with a practical focus on current priority issues.
- Identifying the key issues of assessment process.
- Necessity for establishing continuing capacity for assessment.

These principles are seen as guidelines for the whole assessment process including the choice and design of indicators, their interpretation, and the communication of the results. They are understood as being interrelated and to be applied as a complete set. Furthermore, they are intended to be used in starting and improving assessment activities of community groups, non-government organisations, corporations, national governments, and international institutions.

The OECD (2001) proposes a set of questions that is to be answered for the interlinkage of social, economic and ecological dimensions of water management:

- What is the environmental impact of reducing subsidies to the agriculture sector?
- What are the environmental impacts of alternative agricultural policy instruments, such as direct payments versus market price support?
- What are the environmental impacts of extending current policies into the future?

- What are the economic implications for the agriculture sector of meeting environmental targets, such as those set out in international agreements?

Smith (2004) argues that for the development of an indicator set one first needs to pose the following relevant questions before indicators are defined and measured:

- What key questions must be answered to determine the degree to which the region and the single nations are on a sustainable course with respect to its use and management of water resources? What are the issues that involve water resources?
- What indicators would be most useful in addressing these questions and defining sustainability? How should sustainability be measured and monitored? For what purposes would indicators be useful?
- What water information and statistics are needed to develop indicators? How can this be done? What institutions should carry out these efforts?
- What sources of data or statistics should be considered for developing indicators of sustainable water resources in the Mediterranean? A compilation of possible sources for the US is e.g. maintained on the SWRR website (http://water.usgs.gov/wicp/acwi/swrr/).
- If new data should be collected for these indicators, what organizations should do it and why? What are the gaps in data collection that should be filled? What options exist for filling these data gaps?

In the context of development assistance, and here in the context of evaluating short, middle, and long-term projects, the development of an effective set of indicators is of great importance. Indicators are used for the monitoring and evaluation of development assistance projects, of their effectiveness and of the question to which extend a measure applied is leading towards sustainable development.

In this context, the principles and requirements which indicators have to fulfil can be largely applied in middle- or long-term projects concerning water stress and scarcity. These principles are:

- Validity – measure what they are supposed to measure
- Reliability (verifiable) – conclusions replicable if measured by different people at different times
- Relevance – to the project objectives & different information needs
- Sensitivity – to the situation observed and changeable over time
- Cost effectiveness – worth the time & money to apply them
- Timely – collect data reasonably quickly
- Targeted – specified in terms of quantity, quality, time, target group and location

In the realm of sustainable water management, Saeger (2001) gives a good overview of the characteristic that constitutes a good indicator in general, but especially for the water management. It should

- be representative
- be scientifically valid
- be simple and easy to interpret
- show trends over time

- give early warning about irreversible trends
- be sensitive to the changes it is meant to indicate
- be based on data adequately documented and of known quality
- be capable of being updated at regular intervals

Not all indicators of water can fulfil all these characteristics. In this context, especially the data collection and consecutive documentation is often considered as a big problem in terms of capacity, money, and time.

Many indicators used in current assessment models thus tend to use indicators that use data and statistics, already available. In such models, the focus is set on the question which available data can be used to get the best information, rather than what exactly to measure. The present paper deals with important water management areas to be assessed using indicators, and subsequently with issues of data availability, collection capacities, etc.

A good overview of the technical challenges that one has to face when developing a frame for water management indicators has been given by Smith and Zhang (2004), coordinators of the US-Sustainable Water resources Roundtable. The two most important are:

First, the **number of indicators** to be used: Too many indicators may impede getting an overview of the sustainability problem because of increased complexity. On the other hand, if too few indicators are used, the system may not be represented adequately and important linkages of system dynamics are lost.

The **scale** issue is of general importance in sustainability questions. For the Mediterranean region as a whole other indicators need to be used for the same issue as for the national or local level.

Saeger (2001) also argues that a gap exists in the information base needed to support current and future water management needs. The priority information needs are:

- Diffuse source of pollution
- Emerging issues on human and ecological health
- Relationship between socio-economic driving forces and environmental impacts
- Indicators of the contribution of water to the overall quality of life
- The ability to assess future outlooks and to assess long-term environmental change
- Effectiveness of policy and legislation concerning the water environment.

VII – Existing (sets of) indicators

For the purpose of this paper a broad spectrum of literature dealing with the topic of water resources management has been screened. In many studies different (sets of) indicators are proposed to tackle the different areas identified in chapter 6. Consequently, it seems reasonable to revert to these existing (sets of) indicators, to evaluate them and to identify which of them might be usable for an application in the MELIA context. On the basis of an assessment of different (sets of) indicators using a standardised form, in order to enhance clarity and to enable comparability, in this chapter we present three indicator sets which we propose as a basis for discussion – for the expert interviews as well as for the plenum of the MELIA colleagues:

1. SWAP

SWAP – the Mediterranean Dialogue on Framing Sustainability in Water Policy evaluation – was a project funded by the European Commission, DG Research, within the 6th Framework Programme {SWAP, 2009 #6209}. In the context of this project the experiences of different case studies were compared in terms of what positive or negative effects policies regarding water management had had on sustainable development especially of the water sector. The project involved representatives of various Mediterranean countries (Morocco, Algeria, Lebanon, etc.) and aimed for the exchange of experiences not only among the specific countries but also of the European Union with its Water Framework Directive.

In the SWAP project an indicator matrix was elaborated to be applied in the different participating countries in the Mediterranean region. The matrix was organised using different indicator topics, the main objectives within these topics, and related indicators; additionally specific objectives were defined, and related to them also a set of sub-indicators. The following topics were identified (the numbers in brackets represent the number of objectives, related indicators, specific objectives, and sub-indicators):

- Environmental (1-6-7-24)
- Economic (4-3-7-16)
- Social (3-3-9-12)
- Governance (3-5-3-3)
- Social-Environmental (1-0-4-2)
- Environmental Governance (0-0-3-6)
- Social-Economic (1-0-4-7)
- Social-Governance (2-1-3-4)
- Governance –Economic (1-1-1-0)
- Environmental-Economic (2-1-1-2)

In a next step the indicator set was presented to and discussed by stakeholder groups in three different case study areas. The final set of SWAP indicators was then selected by all local stakeholders through a participatory approach of all concerned in the context of promoting sustainable development. The structure of the final set was similar to the original, using different indicator topics, the main objectives within these topics and related indicators (numbers in brackets: number of main objectives and related indicators):

- Environmental (3-3)
- Economic (1-3/12)
- Social (2-4/2)
- Governance (1-1/2)
- Social-Environmental (1-3/2)
- Environmental Governance (1-8/1)
- Social-Economic (1-2/1)
- Social-Governance (1-2)

- Governance –Economic (1-1)
- Environmental-Economic (1-1/4)

The advantage of the SWAP indicator set is that it has been developed, and is already being applied, in the Mediterranean. The indicators reflect the state of the environment, economy, health, quality of life, social cohesion in a context of sustainable development at local or national level; yet they do not include system description indicators. Definitively, this set of indicators is worth considering when developing a MELIA indicator set.

2. Aquastress

In the Aquastress project ('an EU funded integrated project (IP) delivering interdisciplinary methodologies enabling actors at different levels of involvement and at different stages of the planning process to mitigate water stress problems'; Sullivan *et al.*, 2007) an integrated tool for the evaluation conditions of water stress was developed – the Aquastress Water Stress Matrix (AWSM), combining selected information regarded as relevant for water management decision making.

In addition to the core component, the Aquastress Water Stress Index (AWSI), the matrix includes maps, photographs, comments, and a 'warning system'. The significant range of issues relevant to identifying the causes of water stress was tried to capture by aggregating various indices within the AWSI, which then evaluates the level of water stress at a specific site.

Additionally, Aquastress suggests a set of indicators which enables the assessment of water stress in all the sectors using water - the domestic, industrial and agricultural sector as well as the environment. Each sector is subdivided into the four categories aspects of water quality and quantity, institutional and adaptive capacity, infrastructure, as well as society and equity. From all the collected indicators various were chosen for each category, following a ranking concerning the criteria relevance and data availability (number of indicators within the four different categories).

- Domestic sector (4-3-3-3)
- Agricultural sector (5-4-4-3)
- Industry-production (3-2-2-2)
- Industry-tourism/services (6-5-1-2)
- Environmental components for each sector (4-5-6-2)

The main idea of the list was to create an inventory of indicators that could be used in the test-sites of Aquastress. Also in this project, the water consumption component of a system to be managed seems to be adequately displayed by the indicators. However, the amount of water consumed should be contrasted with information related to the available water resources, including system information such as climatic circumstances, etc.

3. UN Water – Water monitoring

The scope of the study was voluntarily limited to monitoring initiatives which were global in scope and related to one of the following four dimensions: service, quantity, quality and governance. In so doing, the mapping discarded all local, national and even regional monitoring initiatives unless these were part of a systematic global monitoring effort (FAO, 2006).

A total of 44 initiatives were screened, of which 19 were classified as monitoring activities. Thirteen of these 19 initiatives refer more specifically to a narrower definition of monitoring based on compilation of country or point data or country surveys. The responsible institutions range from different UN organisations (e.g. UNEP, UNESCO, etc.) to the WHO, the FAO and many others.

The report suggests a list of Key Water Indicators for UN-Water, subdivided into various subcategories. It is based on work previously done in the framework of the World Water Assessment Programme. It contains a large number of indicators which are already available within UN-Water member databases, some of which are currently under development, and few newly proposed ones.

Target monitoring:

- Sustainable Development (5)
- Millenium Development Goals (2)
- IWRM and water governance (3)

System monitoring:

- Resources (6)
- Stocks and use (9)
- Other sustainability (5)
- Early warning (2)
- Production and use (7)
- Health and social aspects (7)
- Economic aspects (16)
- Quality aspects (10)

The suggested indicator set covers a wide range of fields related to water resources management and the majority of the ones discussed above. In contrast to the other sets described above it includes a sub-set of indicators which are dedicated to 'system monitoring'. These include 'resources' indicators such as precipitation quantity, as well as 'stocks and use' indicators (e.g. renewable water resources), etc. In their report, the UN also proposes a few new indicators which comprise, for instance, 'water distribution and delivery efficiency' or 'rain seasonality index'. Certainly, these two indicators would perfectly fill the gap in data on temporal and spatial variability in water availability. Yet, and this holds also true for quite a few already existing indicators, the big issue – especially in countries with a shorter tradition in (environmental) accounting – is the data availability.

VIII – Conclusion and recommendations

Conclusions

The purpose of the present paper is to give an overview over existing indicator (sets) for water resources management, in order to derive recommendations for the compilation of an adequate set of indicators for the Mediterranean region. To effectively analyse existing indicators sets and look for necessary adaptations for a specific region, it is necessary to understand the setting – the circumstances – in this region. That is why at the beginning we elaborated the role of the resource 'water' in the Mediterranean and the necessities for ensuring sustainable water supply in the Mediterranean. Like in other parts of the world also in the Mediterranean region the management of the water resources is exacerbated by the complexity of water management as such and special issues characteristic for the Mediterranean. In this context, one could name, for instance, the dissimilarity among countries adjacent to the Mediterranean Sea, and the variable conditions even within the specific countries, in terms of water availability, economic conditions, technical development, etc.

As identified in Chapter 4, the main issues to ensure a sustainable management of water resources in the Mediterranean are political as well as technical. What all of them have in common is that, in order to evaluate the current situation as well as to measure the progress towards specific goals, certain indicators are needed. 'You cannot manage what you cannot measure' is a saying fitting perfectly into this context. Despite the existence of well-elaborated indicator sets, one has to take into consideration that all of them have been developed either on a detailed level for a specific setting, or with less detail in order to make it applicable to different settings. Hence, a set of indicators for the Mediterranean will have to be a set tailored to the needs specific for the region.

As said above, political as well as technical measures to improve the sustainable use of water resources depend on the provision of reliable data. However, in this context some political steering is crucial. First, the necessity of comprehensive and reliable data has to be understood by policy makers and the responsibility for data collection needs to be allocated to the respective administrative bodies, in order to ensure continuous collection of the right data. Here, field, planning, and management engineers appear to be the most appropriate to be responsible in following up the data collection and processes. On the other hand, more collective awareness with regard to the problems at local and regional level should be created, as participation of the population is, in this context, a condition for the success of data collection.

Guest commentaries

As elaborated before, managing water resources is a complex task which is difficult to achieve. A comprehensive and well elaborated set of indicators is certainly a good tool to support this aim. To ensure that in the MELIA project we steer into the right direction we invited different experts to comment on the present report and to write a short guest commentary concerning specific questions related to indicator sets for effective water resources management. When inviting the following experts the focus was set on the coverage of different thematic areas related to IWRM in order to ensure the representation of different schools of thought:

Professor Tony Allan, Geography Department, King's College, London, UK – creator of the concept of 'Virtual Water'; a pioneer in the development of key concepts in the understanding and communication of water issues and how they are linked to agriculture, climate change, economics and politics.

Professor Laila MANDI, Environmental Sciences, University Cadi Ayyad, Marrakech, Morocco – since 2001 National Co-ordinator of the cluster of competences on 'Water and Environment'.

1. Tony Allan - main challenges in trying to create an indicator set for water management in the Mediterranean, especially with respect to the biophysical and political differences among sub-regions or countries in this region? What (groups of) indicators should by all means be included in such an indicator set?

Water allocation and management in the Mediterranean

Unfortunately there are no available indicators of the quality of water governance – certainly none that are operational – that would help society manage its water resources in ways that enable the sustainable intensification of water use.

The allocation of water to different uses is everywhere a political challenge. It is particularly a political challenge in a water scarce region such as the Mediterranean. It is necessary to understand the hydrological and economic underlying fundamentals which are relatively easy to identify. It is getting such information into the competing political discourses on water security that is the challenge.

Hydrological and economic indicators

Hydrological and economic efficiency indicators are important. But they will not be rehearsed here as they are academic unless they can have an impact on the political and social processes that determine how water is valued, allocated, managed, re-used and disposed. There are a number of useful approaches that help us communicate about these issues. Recent work on water footprints and virtual water trade by Allan (2003), Hoekstra and Hung (2002), Chapagain and Hoekstra (2003; 2004), Aldaya *et al.* (2009), Garrido and Llamas (2009) provide both approaches and numbers that are more comprehensive than those used in the past to both define and compare levels of water resource security. They include the previously ignored green water in the soil profile which in most economies is the majority water – although not always in the Mediterranean. Especially in its eastern and southern regions where economies such as Egypt (Zeitoun *et al.,* 2010) are almost totally dependent – albeit for only part of their water security – on surface blue waters – the Nile, or Libya which is almost totally dependent on blue groundwater. The northern Mediterranean economies all have substantial green water resources. France is one of the exceptional economies in the world that is a net exporter of virtual or embedded water. These new approaches developed after 2000 also capture the role of international trade in water intensive commodities. Over 80 percent of the economies of the world are net food and virtual water 'importers'. The Mediterranean is unusual in having a net food and virtual water 'exporter' – France.

Other approaches are helpful and provide ways of identifying and quantifying different indicators such as cost, price and value of water resources in the case of Moss (2004); and of the costs of addressing the essential challenges of mobilizing investment to increase water availability and productivity and the relative costs and impacts of these investments the case of (McKinsey 2010). It is useful to note that these indicators have been developed by private and corporate sector players in association with water and water policy scientists.

Indicators of environmentally sustainable management of green and blue water

The above approaches to the hydrological and economic contexts and to the production and productivity of water have been developed by water science and corporate professionals. The sustainable use of water resources and the protection of the environmental services have been promoted by international and national civil movement activists (Zygmunt 2007; SAB Miller and WWF 2009). Identifying and quantifying indicators of the extent to which water resources are being allocated and managed sustainably is at a very rudimentary stage.

Indicators of effective governance of sustainable intensification and national water security

Water security is achieved in all net food and virtual water 'importing' economies outside the water sector. Nearly all the Mediterranean economies are net food and virtual water 'importing' economies. Water security - beyond that which can be achieved by sustainable intensification of the water resources of an economy – is achieved through the diversification of an economy. Diversification is impeded by water scarcity but not determined by water scarcity. Diversification depends on the extent to which the human resources have been improved and the synergies of public and private investment and entrepreneurship have been nurtured and developed. Think Malta: it has less than ten per cent of the water resources – blue and green – for water self-sufficiency. It is water secure because of the quality of its human resources and the effectiveness of its public and private sector productive and regulatory institutions. The identification and measurement of the vast range of indicators that makes up the governance of water resources and the socio-economic contexts in which such governance operates is an elusive and possibly fruitless task. Good governance of water is integral to the good governance of a political economy.

2. Laila Mandi - What are the main challenges when trying to create an indicator set for water management in the Mediterranean region, especially with the aim of integrating gender issues?

In the Mediterranean region, and particularly in the arid, developing countries, water scarcity is very real, with implications for social, ecological order, regional peace and food security. Management of available water resources is therefore a priority. Recognition of the need of integrated water resources management is growing, which requires attention to the human aspects of the use, development and management of water resources. For that reason growing attention to gender is now advancing in most countries of the Mediterranean region. Nowadays, the so-called 'mainstreaming' of gender issues in water resources and the irrigation sector is a top priority on the agendas of international organisations (Minoia, 2007; Hamdy *et al.*, 2004).

Gender plays an important role in Integrated Water Resource Management (IWRM). Not just in the planning process but also through the stakeholder consultations and every other step in between. Gender mainstreaming or gender equality in IWRM is essential for two important reasons. One because women are just as much affected by decisions made with regards to water as men and because achieving gender equality is one of the millennium development goals. For these reasons the challenge is to take gender into account in an IWRM plan to give a balanced and equitable output with everyone's best interests taken into account.

For instance, research shows that the role of women in water management and decision-making is directly linked to other major socio-economic drivers, such as improved sanitation, health, education, (micro-) finance, economic growth, resilience to shocks, and recovery from social conflict, and in the wider issues of governance and basic human rights.

However, a profound gender analysis demonstrated clearly the considerable gap between positive policy intentions and their conversion into concrete actions. Such slow conversion of gender policies into practice, in particular in water resources management and irrigation are the results of the lack of analytical tools and appropriate concepts, the lack of comprehensive conceptual frameworks and appropriate implementation beside the absence of gender performance indicators and above all the vague and weak roles of water institutions and agencies (Hamdy *et al.,* 2004).

According to the outcomes of the Bari workshop (Hamdy *et al.,* 2004), the main problems that are limiting the integration of women in water management are:

1. **Legislation**: Legislation often does not sufficiently consider the access of women to land and water in most Mediterranean countries. Women are absent in the decision-making process, government agencies are not taking enough initiatives in educating women in water management issues. Legislation must be modified to be more gender-sensitive.
2. **Communication and Awareness of Gender Issues**: Education at primary and secondary school, vocational schools and universities in gender issues is of utmost importance for increasing the awareness of the public and the government bodies. Little is done in this important area compared to the actual needs.
3. **Inadequacy of Analysis:** There is a poor analysis of gender issues in water policies. New tools and guidelines are needed.
4. **Lack of Participation of Women in Water Governance:** Women are mainly absent in the management and policy making processes. Very few women are active in Water Users Associations and Water Cooperatives. The same applies to most irrigation and water supply agencies.
5. **Centralization of Water Management and Governance:** There is an excessive centralization of decisions and insufficient knowledge of local problems resulting in very poor technical assistance at local level.

6. **Institutional Capacity:** There is a lack of coordination mechanisms among relevant institutions and bodies within countries and more at regional level and limited skills related to participatory and gender approaches.
7. **Extension**: The extension services directed towards women are unsatisfactory. There are few female extension officers\gender specialists. Training material is rarely gender sensitive.
8. **Impact of Globalization**: Globalization is affecting social roles in rural communities and agricultural management, including irrigation. Many women are changing their attitude towards agricultural work.
9. **Cultural Heritage and Social Norms**: In most countries inequity and inequality are dominant because of social and cultural reasons.
10. **Poverty**: Most working women are engaged in agriculture and are the most disadvantaged group of their society. Due to lack of training and other reasons they remain unskilled workers.
11. **Lack of Access to Information:** There is insufficient knowledge among men and women about their own rights, and there is lack of access for needed information and technology.
12. **Lack of Gender-Sensitive Indicators**: There is an absence of institutional set up that is responsible for monitoring the process of gender integration into water management.
13. **Gender-disaggregated statistical information** A limited availability of statistics disaggregated by sex and therefore it becomes difficult to quantify the gravity of situations related to the access of women and men to land and water resources.

It is recognised that the outputs of the MELIA project will contribute to the future development of methods and tools which will enable important improvements in the capacity of women in developing countries to cope with changes in their environment. Women will be encouraged to participate in stakeholder engagement and capacity building activities. Environmental sustainability is enhanced when the priorities and demands of all stakeholders are addressed:

- Women should be recognized as central to the provision, management and safeguarding of water and environmental management
- Policies and strategies on water and environmental management need to respect gender differences
- Good understanding of gender equality issues is required for adequate implementation of policies and strategies

Recommendations – proceeding further

One of the aims of the MELIA project is to propose a set of indicators applicable in the Mediterranean region, in order to facilitate and improve the management of water resources. As the bottom line of this present review paper, taking into account the guest commentaries, we suggest proceeding further in the following way:

As a first step a general feedback round seems to be advisable in which the MELIA partners comment on the present paper giving input such as additional issues necessary to be covered, more existing indicator sets, etc. Last inputs will be collected at the 4th MELIA project workshop in March 2010 in Amman, Jordan.

The paper presents three specific existing sets of indicators which have certain potential of being applied in the Mediterranean. MELIA partners could build on the experiences made (many of them were already part of other projects elaborating indicator sets) and use the existing sets for a

possible adaptation of an indicator set already applied nationally. An additional option could be to discuss the elaboration of a MELIA indicator set by means of a project workshop.

While it would be crucial for the workshop to invite also representatives of national institutions now responsible for the data collection, in order to get an insight in data availability and consequently the feasibility of the elaborated indicator set, in general, special caution has to be applied no to depend too much on indicators, as often specific indicators are based on weak assumptions leading to confusing results.

There is no one ideal indicator set for the management of water resources in the Mediterranean. The process to get to the best-suited set has to be understood as participatory, integrative and iterative. In this spirit the present paper constitutes the first iteration step in this fruitful procedure.

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(1) Note: 'Blue' water is water withdrawn from rivers, lakes, or aquifers, while 'green' water is water from precipitation.