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Facets of Modern Water Resources Management: Prolegomena

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Thirty years ago, a new journal, WATER RESOURCES MANAGEMENT, was launched by the Dutch publishers D. Reidel, as one of the first activities of the just established then new association with the name "European Water Resources Association" (EWRA). The Association was established in Athens during the International Symposium on "Water Resources Management for Agricultural Development," held at the National Technical University of Athens in 1986. EWRA's first interim Council, consisting of J. Nemec (President), J. Kindler, M. Benedini, G. Tsakiris and L. Molnar (members), decided to launch the journal with the aim to assist the international water resources scientific community to publish research on real water problems, accommodate the exchange of experiences among the scientists and engineers from various countries of the world, and facilitate the cooperation between the research community and the policy makers. This meant that the emphasis had to be given on the real-life water resources problems, which were expected to become more crucial in the following decades. Therefore, researchers had to provide innovative methods and tools to support a more scientifically sound decision-making process by addressing the present and the emerging challenges related to water issues.

The years passed by and the journal gradually attained strength and influence. From a modest publication sequence of 4 issues per year, it now publishes 15 issues per year. So far, the journal has published 3221 research articles in 253 issues. At the same time from Reidel the journal passed to Kluwer Academic Publishers, and then to Springer and Springer Nature. All performance criteria, e.g., number of citations, impact factor etc. have been steadily increasing up to now, placing the journal among the top journals in the field. Figure 1 shows the performance of Water Resources Management related to the citations and the Thomson Reuters Impact Factor.

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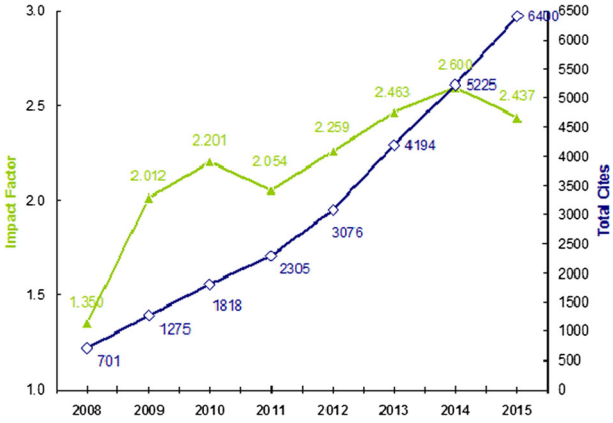

Fig. 1 The impact factor and the total cites for the period 2008–2015

Today, thirty years later, all of us who initiated and supported this long-lasting effort, are proud that the Water Resources Management is recognised as the leading journal in the area of water resources bridging research with policies and practice.

Obviously, many changes in water resources management (WRM) occurred during this 30 year-period related to the concepts and practices. In 1987, the sustainability concept was introduced after the report of Brundtland's commission. Also new concepts such as Globalisation, Integration, and Adaptiveness were introduced mainly by academics in international conferences, books and journals, and to a lesser extent in the legislation on water resources management. During these last few decades the objectives and the definitions of WRM also changed significantly. From the main objective to fulfil the needs for water of the various sectors of water consumption (municipalities, agriculture, industry, tourism etc.) in an efficient way, we have reached the stage at which the main objective is to attain good health of the water bodies, the fauna and of course the humans. According to a more technical paradigm, WRM is conceived as the total set of coordinated cost-effective decisions, measures, and actions (including investments, legislation, planning, monitoring and organisational efforts), taken democratically, which aims at achieving a harmonious and sustainable relationship among all related elements of the water system for the present, and future time horizons (Tsakiris 2015). By related elements we mean mainly the three poles of the water system: water availability sources, water consumption centres and the environment (health of ecosystems and status of water bodies).

In the real world also, many changes have occurred during the last three decades. The water resources problems multiplied, the demand for water for urban consumption, agriculture and industrial uses has increased, the water scarcity and water pollution have intensified and expanded affecting more regions, the vulnerability of ecosystems and societies towards water related hazards have been multiplied. On top of these negative developments, the ongoing climatic change, the conflicts and the civil wars, which have increased the hardship of the people leading to massive people mobility, create severe tensions and disputes between countries.

On the other side, new technologies and management tools have been developed and applied assisting in alleviation and mitigation of these problems. At the same time, huge cooperative systematic attempts were advocated mainly by the rich nations of the north to stop the deterioration of the existing conditions and improve the health of the water bodies. A great

example in this category of systematic efforts is the enforcement of the water policies of the European Union (through the water framework directive and several other additional directives) to bring all waters in the territory of its member states to a good quality status at certain target horizons. These attempts, however, affect a relative small number of developed countries and have a remarkable but not overwhelming success so far.

In the rest of the world, apart from the efforts of the United Nations and the other international organisations, efforts are only made by a small number of countries. The situation is deteriorating in the poor countries mainly due to the lack or aging of infrastructure, the increasing population of the urban centres and the recurrent drought events. Every year a large part of the globe is hit by an intense and persisting drought. African countries seem to suffer more with a large number of casualties/fatalities. This year is one of the worst dry years for Ethiopia. It is also the year in which more than one third of India's population is suffering from a catastrophic drought.

In this context, the burden of the journal as a principal medium of cooperation between the scientific society and the decision makers (managers, authorities, stakeholders), is expected to be even heavier.

In this benchmark Special Issue, devoted to the 30-year anniversary of *Water Resources Management*, with the title "Facets of Modern Water Resources Management", we attempt to review the most remarkable developments in water resources management for the last 30 years, and at the same time to identify trends and tendencies which will characterise the future decades.

The papers included in this Special Issue cover a spectrum of diverse topics and are written by experts in these topics. They are briefly presented below in the sequence they appear in the issue.

Loucks (2017) has the opinion that systems analysts should address broader global issues in ways that lead to beneficial impacts and reduced health and security risks for all of us in our world. However, this is a difficult task since we must work in a political environment of conflicting stakeholder expectations.

Pahl-Wostl (2017) supports the thesis that many water related problems can be attributed to governance failure at multiple levels of governance rather than to the resource base itself. She reckons that there is a sign of a paradigm shift in the water research community that moves from the technical/engineering focus towards a broader understanding of water management.

Simonovic (2017) provides a review of water resources management challenges posed by climate change. Apart from the discussion on global climate models, emission scenarios and downscaling, the paper gives a practical example for updating the IDF curves under changing climate.

Garrote (2017) reviews the current knowledge on approaches addressing water issues under uncertainty in water-scarce regions with the aim to identify policy actions for climate adaptation. In this context, he gives an overview of expected impacts of climate change on water resources and presents a spectrum of adaptation choices. He concludes by proposing the extension of water management paradigm to include, apart from the technical and economic criteria, the ecological and social considerations.

O'Connell (2017) elaborates on the inclusion of climate change in the water resources projects. He argues that there are high uncertainties in the General Circulation Model (GCM) projections and elusive evidence for the influence of anthropogenic changes on precipitation and streamflow records. The author proposes that a baseline risk assessment should retain the assumption of stationarity and be assisted by the observed interannual variability, and where

appropriate, by amendments based on reliable information from GCMs. He emphasises the fact that there are also other more important drivers (e.g., globalization and socio-economic changes) to be considered. He suggests that more attention should be paid to adaptation to the changing socio-economic conditions. Finally, he argues that efficient water resources modelling has to incorporate the human dimension more explicitly.

Pereira (2017) touches the topic of water in agriculture and food production. He reckons that the need for sustainable food security for our global population and the requirement for preserving the environment have imposed the necessity for integrated, participatory and scalable solutions, focusing on various levels of agricultural water management. The author states that the cornerstone for producing food for supporting the increasing population is the effective irrigation management.

Harmancioglu (2017) gives an overview on global water policy development of the last three decades starting from the Agenda 21 which was the first to officially introduce and support the concepts of sustainability and holistic water resources management. She presents the main contributions of all milestones in water policy development during this period. Further emphasis is given by the author to the Sustainable Development Goals that extend the Millenium Development Goals and the priorities of Rio + 20. The new goals aim to balance the economic, social and environmental dimensions of sustainable development.

Grafton (2017) highlights the key trends and projections in water scarcity and water insecurity. The paper explains how the water pricing option can be applied to respond to water insecurity from both the demand and supply perspective. Also, the author gives guidelines for the efficient and equitable allocation of water responding to the "wicked problem" of insecurity.

Maia (2017) gives an overview assessment of the first round of Water Framework Directive (WFD) implementation in the European member states. He points out that significant progress towards the ecological and other objectives has been made by the member states during the last 16 years, mainly related to the status of water bodies in the member states. However, the objectives set by WFD are still not reached. The author identifies a number of causes which have to be overcome during the next implementation period for achieving the very ambitious goals of the WFD.

Hoekstra (2017) reviews the evolvement of water footprint assessment (WFA) as a new research field during the past few years. The paper reflects the main issues of the debate on this quickly emerging new field in a narrow and a broader framework.

Tsakiris (2017) reviews the progress made in the last three decades for the identification and assessment of drought phenomena, and the estimation of consequences from intense and persistent drought episodes. Emphasis is given to drought risk assessment of the affected systems using a systems approach and the hazard-vulnerability nexus. He also gives guidelines for an effective proactive planning against droughts involving authorities and stakeholders.

Cancelliere (2017) recognizes the growing need for new methods which take into account non-stationarities in hydrometeorological variables. He focuses on non-stationary analysis of droughts proposing a methodology which computes the probability of drought length at certain time under the assumption that the probability of deficit varies in time. The methodology is applied in Sicily using long annual precipitation series.

Todini (2017) reviews the developments of real time forecasting systems over the last few decades. The paper shows that recent probabilistic flood forecasts are more robust and

effective than traditional deterministic methods. These recent probabilistic methods can also incorporate deterministic information from a variety of models of different nature into a unique predictive procedure.

Schumann (2017) discusses the change in flood management from the design flood approach to modern flood risk management approach. He also states that since the existing probabilistic tools are not sufficient, multivariate statistics may offer solution to flood management problems which are still unsolved.

Singh (2017) discusses the overland flow modelling by the Kinematic wave theory (KWT). The paper revisits the KWT from fluid mechanical and mathematical points of view. Mathematical formulations of the KWT are provided, dependent on the class of overland flow problem. Also, particular emphasis is given to the accuracy aspects of KWT approximations.

Srivastava (2017) expresses the opinion that accurate measurements of soil moisture are essential in order to develop early warning systems to mitigate the impacts of floods and droughts, and generally to assist in efficient water resources management. This can be achieved by advanced satellites with high penetration power together with efficient retrieval techniques.

Boulos (2017) admits that the urbanisation challenge has begun to strain water conveyance systems (and particularly urban drainage systems) designed and operated using traditional management methods. He proposes "smart water network models" which can continuously monitor and minimize public exposure and risk. These models/tools integrate dynamic network simulation and optimisation models using GIS and SCADA support.

Tanyimboh (2017) elaborates on the method of flow entropy as a surrogate reliability measure in water distribution systems. The paper describes a multi-objective genetic algorithm, which maximises the flow entropy under multiple operating conditions and can be applied to any water systems.

Tayfur (2017) gives an overview of the most popular modern optimisation methods which have been widely employed in applications in the area of water resources planning, engineering and management. The paper briefly presents their theoretical background and specifies areas of application related to water resources.

Karatzas (2017) reviews the numerical models which have been employed throughout the period of the last few decades for groundwater flow simulation and transport. The paper presents in brief the phases of building a groundwater model. It also presents the most popular groundwater models, which are widely used in common engineering applications.

Tsihrintzis (2017) presents solutions for wastewater treatment of small communities and settlements through the use of vertical flow constructed wetlands. Constructed wetlands are alternative systems to conventional biological wastewater treatment plants. The author presents the advantages and disadvantages of these systems and the various types of wastewaters and pollutants that can be treated. He also describes the processes involved and the expected treatment performances.

Starrett (2017) elaborates on the ethical dimension of engineering decisions. There are many ethical dilemmas which young professionals in water resources and the environment may face. He notes that the engineering decisions should be supported by the Code of Ethics, increasing the chances of more appropriate and acceptable decisions for the benefit of the society.

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