통합물관리를 위한 의사결정지원시스템 검토

A View of Decision Support Systems for Integrated Water Management

Jia Peng* · 안선복** · 서영민*** · 지홍기****

Jia Peng · An, Shan Fu · Seo, Young Min · Jee, Hong Kee

요 지

수자원시스템은 매우 복잡한 시스템이고 또한 물리학, 생물화학, 생태학, 사회학, 추계학 및 정책 등의 내부 독립적인 복잡한 시스템의 영향을 받는다. 의사결정지원시스템의 발전은 내부 관련된 시스템과 의사결정자와 결합하여 종합적으로 구조와 비구조적 조치를 고려하고 시스템분석방법 및 컴퓨터기술을 이용하여 수자원시스템의 문제를 돋거나 해결한다. 컴퓨터의 의사결정시스템을 수자원시스템 관리에 응용한 역사는 벌써 20년이 된다. 본 연구에서는 종합수자원관리 및 의사결정시스템이 종합수자원관리에 대한 응용과 발전에 대하여 검토한다.

key words : 통합수자원시스템관리, 의사결정지원시스템, 수자원시스템

1. Introduction

Water resources systems are far more complex than anything analysts have been, perhaps will be able to model and solve. The reason is not simply any computational limit on the number of model variables, constrains, subroutines or executable statements in those subroutines. Rather it is because we do not understand sufficiently the multiple interdependent physical, biochemical, ecological, social, legal and political (human) processes that govern the behaviour of water resources systems. Although the development and application of modeling technology provides a way of predicting the behaviour of proposed infrastructural designs and management policies, however models do not produce decisions. Water resources planners and managers today must consider the interests and goals of numerous stakeholders. It requests an approach of integrated water resources management and implementing decision support systems.

2. Approach

2.1 Integrated Water Resources Management

With the growing pressure on our water resources systems caused by growing population and socio-economic development, the concept of integrated water resources management (IWRM) has been developing since the beginning of the eighties as a response approach. The Global Water Partnership (GWP) gives a definition of IWRM as, IWRM is a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and

* 정회원·연남대학교 건설환경공학부·석사과정·E-mail: Jerzy.peng@gmail.com

** 정회원·연남대학교 건설환경공학부·박사과정 E-mail: elofy@mate.com

*** 정회원·연남대학교 건설환경공학부·박사과정

**** 정회원·연남대학교 건설환경공학부·교수 E-mail: hkjee@yu.ac.kr

social welfare in an equitable manner without compromising the sustainability of vital ecosystems (GWP, 2000). It shows a change of water management trends from traditional supply-oriented, engineering-based approach towards to a demand-oriented, multi-sectoral approach. Fig 2.1 shows the three pillars of GWP's IWRM approach. Implementing an IWRM process is in fact, a question of getting the "three pillars" right: moving toward an enabling environment of appropriate polices, strategies and legislation for sustainable water resources development and management; putting in place the institutional framework through which the polices, strategies and legislation can be implemented; and setting up the management instruments required by these institutions to do their job (Torkil Jonch-Clausen, 2005).

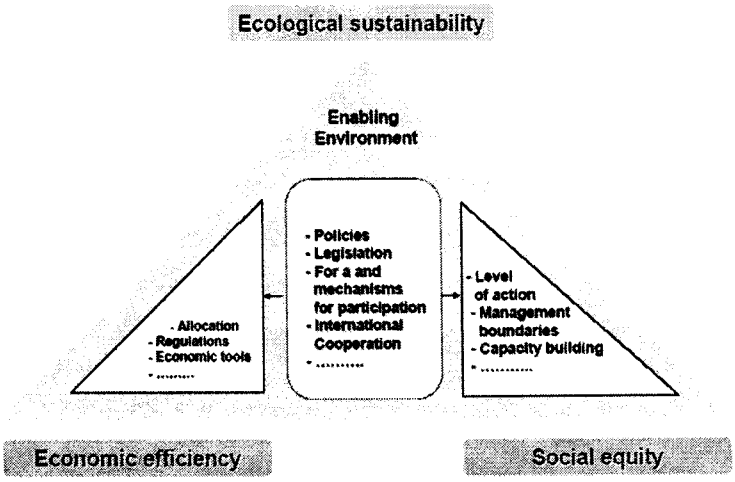

Fig 2.1. The Three Pillars of IWRM

IWRM is about strengthening frameworks for water governance to foster good decision-making in response to changing needs and situations. It seeks to avoid the lives lost, the money wasted, and the natural capital depleted because of decision-making that did not take into account the large ramifications of sectoral actions. It aims to ensure that water is developed and managed equitably and that the diverse water needs of women and the poor are addressed. It seeks to ensure that water is used to advance a country's social and economic development goals in ways that do not compromise the sustainability of vital ecosystems or jeopardize the ability of future generations to meet their water needs. This is best reflected in the Dublin Principles of 1992, which have been universally accepted as the base for IWRM.

2.2 Decision Support System

A Decision Support System (DSS) for water resources management is an integrated, interactive computer system, consisting of analytical tools and information management capabilities, designed to aid decision makers in solving relatively large, unstructured water resources management problems (McKinney, 2004). DSSs for water resources problems began to appear in the mid-1970s and have been discussed in the literature since the mid-1980s (Loucks et al., 1985; Labadie and Sullivan, 1986; Loucks and Da Costa, 1991; Fedra, 1992; Georgakakos and Martin, 1996; Waltkins and McKinney, 1995; Loucks, 1995; McKinney et al., 2000). Fig 2.2 gives a general view of the components of many decision support systems. These interactive modeling and display technologies can, within limits, adapt to the level of information needed for water resources management and can give decision-makers some control over data input, model operation and data output. The increasing developments in computer technology - from microcomputers and workstations to supercomputers - and the computer programming approach - from structured procedure programming approach of Fortran to the object-oriented programming approach of

C, C++ and Java - have motivated the concurrent development of an impressive set of DSSs software. As far as now there are several successful specific DSSs softwares have been developed and applied to the global basins, including flood management decision support system such as CWMS (Fritz, J.A., et al., 2002) developed by the U.S. Army Crops of Engineers, SMS (EMRL, 2004) and WMS (Gils and Groot, 2002; Gils et al, 2004) developed by Environmental Modeling Research Laboratory at Brigham Young University, and water allocation decision support system such as Delft-Tools (Delft Hydraulics, 2004), Mike-Basin (DHI, 2004), ModSim (Labadie et al., 2000; Shannon, et al., 2000; Dai and Labadie, 2001; Labadia, 2004). and water quality decision support system such as Basins (USEPA, 2004), etc.

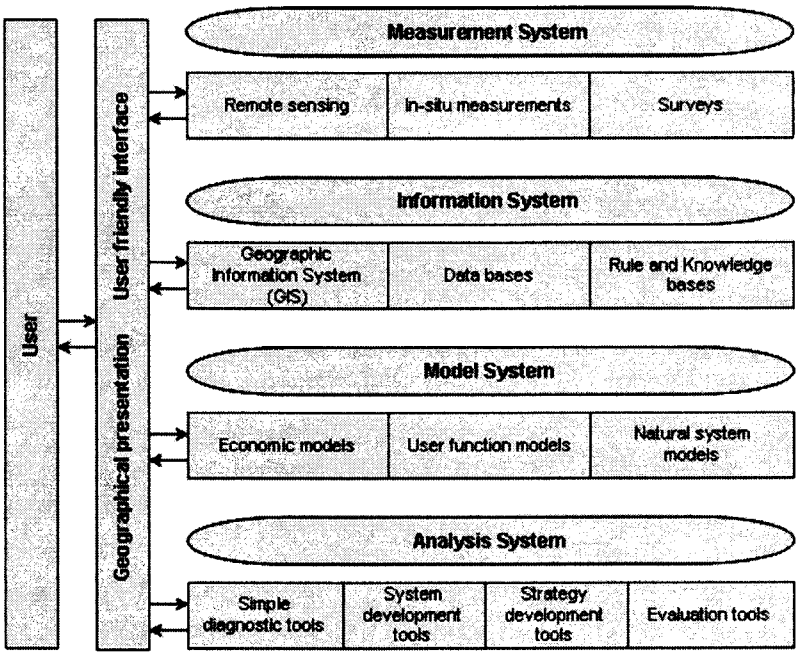

Fig 2.2. Common many components of Decision Support Systems (adapted from Loucks, 2005)

There are a number of issues related to water management that must be considered when designing a DSS for effective decision making on IWRM. McKinney (2003) outlines three points on constructing a water management DSS, 1) water management takes place in a multidisciplinary and multi-jurisdictional environment and the problems must be approached from an integrated perspective; 2) water management must be considered at the scale of river basin in order to internalize the major, potential externalities between activities of users in different parts of a basin; 3) the importance of scale effects in trying to model the integrated effects of water uses across an entire basin must be addressed.

3. Conclusion

Given the increasing complexity and disciplinary breadth of water management problems, DSSs have become necessary to make models more useful. However, the development and application of DSSs to water resources management is far from a mature field for a number of reasons, including a lake of case studies in which the performance of DSSs has been evaluated in appropriate institutional settings; the multidisciplinary nature of DSSs and their theoretical underpinnings; and the lack of available methods to measure the effectiveness of them. Our challenge is to help stakeholders achieve a common understanding or vision of how their water resources system functions and how it can be managed to

provide improved benefits and less losses, however measured, to everyone impacted.

References

1. Elsevier, (2002). DSS: directions for the next decade. Journal of Decision Support System (33), 105-110.
2. Elsevier, (2007). Environmental decision support system: Current issues, methods and tools. Journal of Environmental modeling and software (22), 123-127.
3. GWP. A handbook for developing integrated water resources management (IWRM) and water efficiency strategies. Http://www.gwpforum.org.
4. Loucks, D.P., and Eelco Van Beek. (2005). Water Resources Systems Planning and Management: An Introduction to Methods, Models, and Applications. UNESCO and WL | Delft Hydraulics.
5. Loucks, D.P., (2006). Modeling and managing the interactions between hydrology, ecology and economics. Journal of Hydrology (328), 408-416.
6. McKinney, D.C., (2004). Report of International Survey of Decision Support Systems for Integrated Water Management. Romania.
7. Ralf Denzer, (2005). Generic integration of environmental decision support systems - state-of-the-art. Journal of environmental and software (20), 1217-1223