

Multiple criteria decision analysis (MCDA): A tool to support sustainable management of groundwater resources in South Africa

Kevin Pietersen

Water Research Commission, Private Bag X03, Gezina, 0031, South Africa

Abstract

The National Water Act (NWA) of 1998 has been promulgated in South Africa to support the attainment of sustainable water resource use. Before the Act was promulgated, landowners were entitled to unlimited groundwater use. The Act rectified this anomaly; however, the practical application of sustainable development concepts in groundwater resource management will be complex. A multiple criteria decision analysis (MCDA) approach was used to identify critical alternative courses of action and to develop a decision-making framework for sustainable groundwater management. Through applying the decision model described in this paper a number of strategies have been proposed which are aligned to the legislative requirements of the NWA.

Keywords: groundwater management, multiple criteria decision analysis (MCDA), value function methods, decision model

Introduction

South African water legislation considers groundwater as a national resource to be managed in a sustainable manner. The Water Services Act and National Water Act (DWA, 1997; DWA, 1998) provide the framework for delivery of water services while also providing a combination of legal obligations, rights, responsibilities and constraints for the sustainable development and management of water resources in South Africa.

The National Water Act (NWA) furthermore provides the framework for the attainment of integrated water resource management (IWRM) principles. The Act recognises the unity of the water cycle, and the interdependency of all its elements, both in terms of quantity and quality. There is further recognition that the protection of water resources falls within a broader framework of integrated environmental management. The requirements of the NWA represent a challenge to groundwater resource managers at an operational level. Before the Act was promulgated, landowners were entitled to unlimited use of groundwater resources.

The focus of groundwater management in South Africa, for the foreseeable future, will be on equitable allocation for economic development, maintaining resource integrity and meeting basic human needs. The challenge is to implement these principles in reality. Management strategies will be needed to address the unique characteristics and roles of groundwater, while at the same time preserving the concept of a common resource, in the context of both continuity within the hydrological cycle and national ownership of the resource.

Groundwater management

The practical application of sustainable development concepts in groundwater resource management remains one of the greatest challenges. Fortunately, a number of authors have begun to examine the concept of sustainable groundwater management (Braune, 2003; Morris et al., 2003; Alley and Leake, 2004; Pietersen, 2004; Maimone, 2004 and Kalf and Woolley, 2005).

Morris et al. (2003) argue that the conventional approaches to groundwater management in developing countries must be reassessed as these systems presuppose the existence of institutional, legal and technical preliminaries that are simply not in place. A groundwater management approach is advocated by Morris et al. (2003) who propose a more holistic approach to sustainability in which coping strategies as well as technical measures form part of the groundwater problem-solving process. Alley and Leake (2004) have a similar view, stating that a key challenge for sustained use of groundwater resources is to frame the hydrological applications of various alternative development strategies in such a way that their long-term implications can be properly evaluated. Each hydrological system and development situation is unique and requires an analysis adjusted to the nature of the water issues faced (Alley and Leake, 2004). Maimone (2004) introduced a number of considerations that must be addressed in defining sustainable yield of an aquifer system. These include consideration for the hydrological system, the concerns and needs of the inhabitants, the potential impacts to groundwater quality, and environmental side effects (Maimone, 2004).

As a result of the above reassessment of the problem of sustainable groundwater management, methodologies are required that facilitate a more holistic approach to sustainability in which coping strategies as well as technical measures form part of the groundwater problem-solving process. This is supported by research that suggests that strategies that build on existing trends within society or help populations to adapt may be effective as strategies that attempt to manage the groundwater resource base

☎ +27 12 330 9027; fax: +2712 331 2565;

e-mail: kevinp@wrc.org.za

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