WATER AND DEVELOPMENT: SOME SELECT ASPECTS

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Summary

This article provides an overview to the contributions under this theme which consider how human activity and water resources interact and the outcomes these interactions have for sustainable development. It reviews the major issues raised by the contributions including the topics of dams, water valuation, arid regions, water-management, and conflict over water resources. It considers the implications which contributions have in each of these areas as well as introduces additional issues relating to the future of dams, innovative ways of increasing water supply, transboundary water resources, and the implications of global climate change for water resources.

1. Introduction

Water is perhaps the most critical natural resource upon which humans depend. Agricultural and food production, trade and ultimately the economic development of all regions of the world depend on rivers, streams, dams, oceans and other water resources. This critical relationship has persisted through the agricultural and industrial revolution and into the era of economic globalization. The relationship between human activity and the water resources on which it depends also continues to be reciprocal. Human consumption, energy, agricultural, industrial and other economic activity have

significant impacts on water quality and quantity for better or worse. A key element of sustainable development rests on our global capacity to interact with the water resources on which we depend in ways that preserve them for our use and that of future generations.

The articles within this theme range from the general to the specific in considering how human activity and water resources interact and the outcomes these interactions have for sustainable development. Agriculture and Food production are two of the most critical human activities that link humans with their water resources. A pair of essays in this section take a broad overview of the critical links between food, agriculture and water use that have evolved over time (Klohn) and those which may exist in the future (de Fraiture et al). More specific topics linked to food and agriculture activity in this section address the impacts of aquaculture and mariculture (Stanley) and water-management institutions (Merrey et al). Energy production is another major human activity which drives human-water interactions and this section includes a contribution (Goodland) that looks at hydroelectric power or dams, which have become a widespread if often controversial energy resource.

Developing regions receive particular attention here in terms of human-water interactions including consideration of water resources and sustainable development in general in the South (Turton), water valuation issues (Borgoyary), and the specific challenges that confront arid regions (Beaumont). A case study of Mexico City (Izazola) provides specific insight into both the historical and contemporary factors that shape human-water interactions in an urban setting and one of the worlds largest developing cities. Several contributions also address cross-cutting issues including conflict and water resources (Ohlsson), human health (van der Hoek), and gender (Sudman). We now consider more closely the issues raised by the individual contributions.

2. Issues Raised by Contributions in Under this Theme

2.1 Human-Water Interactions Linked to Food, Agriculture and Energy Demands

Food production is a key activity that links humans and water resources. Wolf Klohn (*Water, Agriculture and Food Interactions*) provides a comprehensive review of the main elements that drive and shape human agricultural activity and water resources considering the forces shaping agricultural production, the characteristics of water used for food production, the future outlook for water in food production. He also considers some issues for special consideration including adapting to water scarcity; rural poverty, water and food security; the special role of groundwater; and impacts of agricultural activity on aquatic environments. An important conclusion he arrives is that overall agricultural production constraints, including water scarcity, are not as yet a cause of food insecurity: more food could be produced on the globe if the poor could exercise demand for it. In this context, small-scale irrigation may offer better opportunities for empowering the poor when these obtain secure rights to land and water, and consequent access to credit and extension services.

De Fraiture et al (*Food and Water Demand and Supply in 2025*) provides a view into the potential ways in which human food demands and water resources may interact over

the next several decades. They explore when human society will start to reach the limits of its renewable water resources and the potential for reducing future requirements by improvements in managing water resources or changing consumption patterns. To do this they generate a "PODIUM" model to explore different scenarios of future global water resource use as well as sensitivity in water supply to population, diets, efficiency in irrigation, and productivity in irrigated and rain-fed agriculture. They conclude that changing to a less meat-intensive diet could save some water, but it depends heavily on in which countries this change takes place. Consuming more vegetables may offset gains made in consuming less meat. Also, there are gains to be made in water savings in agriculture, but these are far more limited in magnitude than commonly thought. Productivity gains in both irrigated and rain-fed agriculture certainly hold the most potential for reducing the need for additional water resources. But this will require significant changes in the way agriculture is carried out in developing countries.

Increasingly important in the context of human food production is the use of water resources for aquaculture and mariculture. Denise Stanley *(Best Management To Reduce Waste Pollution: The Case of Mariculture*) addresses the important but less often considered issue of pollution generated by these activities. She considers how in the management of this pollution consensus has moved away from regulatory approaches to the adoption of best management practices to reduce water pollution. Six best management practices for mariculture are reviewed by her, followed by a focus on reduced water exchange. She also reviews the private costs and benefits of adopting this technique and looks at an analysis of data from a water exchange experiment carried out in Ecuador in 1996. She concludes that an approach of adopting several best management practices simultaneously is best so that productivity losses can be minimized.

Water-management institutions are also a key factor shaping human and water interactions driven by food and agricultural activity. Merrey et al (*Institutional Requirement for Effective Water Management*) address the issue that management institutions require radical reform if they are to meet the challenges (such as increasing food production from irrigated agriculture, escalating water demands, sustaining the quality of soils and water, and improving the equity of water distribution) facing them during the next few decades. They conclude that the five most important institutional changes required are: (1) replacement of administrative with service delivery organizations; (2) conversion of irrigation systems into multi-use water service systems; (3) transcending the infrastructure dependency—deterioration trap; (4) establishing legal and regulatory frameworks for sustainable water management; and (5) implementing integrated water basin management.

Human demands for energy, in particular hydroelectric energy, are another key factor that shapes human-water interactions. Robert Goodland (*The Future of Big Dams*) takes a comprehensive look at the use of hydroelectricity in developing countries for flood control, water supply and navigation. He considers reviews some of the recent controversial dams debates and the international controversy for and against big dams. He concludes that despite these controversies dams will remain an important source of energy because they are more renewable than other energy options but that greater effort

needs to be put into making hydroelectric sources of energy more fully environmentally sustainable.

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Biographical Sketches

Dr. Catherine M. Marquette wrote this paper while a Research Associate at the Christian Michelsen Institute in Bergen, Norway. She is a demographer specializing in population and environment relationships and has carried out research in Ghana, Zimbabwe, and the Ecuadorian Amazon. She is currently co-coordinator of the Population Environment Research Network of the International Union for

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