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MANAGEMENT *of* WATER DEMAND *in* AFRICA *and the* MIDDLE EAST

CURRENT PRACTICES *and* FUTURE NEEDS

EDITED BY
DAVID B. BROOKS, EGLAL RACHED, AND MAURICE SAADE

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Foreword

Throughout Africa and the Middle East, supplies of fresh water for growing and processing food, household and urban uses, and industrial cooling and processing have not kept pace with population growth and economic growth, both of which are occurring at varying rates throughout the region. Of course fresh water in place serves many other social and economic goals, including fishing and transportation; and it is increasingly recognized that fresh water also provides a large range of environmental services including habitat preservation, flood control, and dilution of wastes. Additional sources of supply are becoming scarce and more expensive to develop. Widespread pollution and salinization of surface and ground water sources are further reducing available supplies. In these circumstances, water demand management offers perhaps the only significant hope for major improvements in the standard of living and quality of life for people living in Africa and the Middle East.

The need to control the demand for water is perhaps most evident in North Africa, the Middle East, and South Africa. Current projections show water availability per capita falling by 80% in these regions between now and 2025. Apart from long-distance transportation and desalination, demand management offers those regions their only hope to improve significantly the balance between water supply and water demand and avoid precipitous drops in availability. Absolute levels of water supply are less of a problem in parts of Western and Central Africa, which still have large sources of potential supply, but the costs of exploiting new sources are increasing rapidly. Demand management also offers an approach to improving water quality, which is a huge problem in this region. Eastern Africa and the drier parts of Western and Central Africa face both serious water shortage and water quality problems. At the same time important options to expand supply remain, at least in some countries. In all parts of the region, deterioration in environmental health damage is evident from attempts to push water supply beyond safe limits, and neglect systems for wastewater disposal. The effects on many communities, cultures, and ethnic groups have been devastating. From all these perspectives, demand management has much to offer.

The International Development Research Centre (IDRC) has identified water demand management in Africa and the Middle East as one of its priority research areas. We therefore pledge to react fully to the results of this workshop. Within the limitations of our budget, we will welcome sound proposals to deepen and extend current research as well as disseminate results from such research, and ensure that they are carried forward into appropriate policies and programs for the citizens of the region.

Eva Rathgeber
Regional Coordinator, Africa and the Middle East
IDRC

Preface

Despite its existing and potential importance, water demand management (WDM) has received relatively little attention from African researchers, and only somewhat more from Middle Eastern ones, especially when compared to the extensive research on geological, hydrological, economic, and engineering aspects of water supply. This is unfortunate, as demand management is based on sound theory: it concentrates on understanding and modifying consumption habits so that water is used more efficiently, and its quality is preserved. Demand management is put into effect by a broad range of practices and measures. These include economic incentives or disincentives, institutional reforms, and revised legal regimes; intermediate and advanced technologies to increase water efficiency; education and persuasion. The selection of practices and measures is a delicate choice, as it must carefully and simultaneously consider economic efficiency, social equity, environmental sustainability, and political acceptability. If that choice is to be informed and deliberate, it should be based on solid research results.

First workshop

As one way of correcting the absence of research on WDM in Africa and the Middle East, IDRC launched a project in 1994 called the Pan-African Initiative on Water. One of its first activities was to convene a workshop in Cairo in December 1994 to identify challenges and opportunities for research on water management. The proceedings of the workshop were published by IDRC in 1996 (Rached, E.; Rathgeber, E.; Brooks, D., ed. 1996. Water management in Africa and the Middle East: Challenges and opportunities. IDRC Books, Ottawa, Canada). It concluded with a number of recommendations for action. One of the most important was a strong call for the formation of a network of researchers on WDM. Such a network was clearly perceived to be strategic both because water scarcity is common to many parts of the region and because WDM can contribute substantially to reducing water stress and improving water availability.

In response to this recommendation, IDRC gave itself the objective of promoting, advocating, and supporting research on WDM concepts and tools, and their utilization throughout Africa and the Middle East. As part of this objective we wanted to consult as many researchers and policymakers from the region as possible, and to gain their advice on the most urgent WDM issues, as well as on ways to ensure that research results moved quickly from concept and study to policy design and program implementation.

Second workshop

This second workshop, held in Cairo in May 1997, was organized to pursue the initial consultation. Its key objectives were the following:

1. to identify research gaps in WDM in Africa and the Middle East; and

2. to determine whether there was a real need for one or more formal WDM research networks in Africa and the Middle East, and, assuming that there was, to define their role, mandate, and implementation modalities.

While the two objectives for the workshop apply to all parts of the region, we expected that the research priorities, networking needs, and modalities would be somewhat different for each of four subregions (the Middle East and North Africa [MENA]; Western Africa; Eastern Africa; and Southern Africa). For example, outputs from the earlier Pan-African workshop on water management as well as IDRC's own research support activities clearly showed that given the critical scarcity of water resources in the large majority of MENA countries, and the absence of viable and sustainable options to increase the water supply, WDM had already begun to draw the interest of researchers and policymakers, especially over the last few years. We therefore anticipated that conditions would be ripe for the establishment of a research network on WDM in the MENA subregion. This position was in fact confirmed by the workshop participants.

We were also aware of a growing number of activities related to water demand management in Southern Africa, where water scarcity is just now coming to be an important and politically relevant issue. Although we believe that conditions there may also favour the establishment of a network, a key issue that we wanted to discuss during the brainstorming sessions was to identify a potential niche for IDRC and avoid possible duplication with similar work already under way at other institutions. The establishment of a WDM research network in Southern Africa will likely constitute an important follow-up activity resulting from the workshop.

The picture is less clear for Eastern and Western Africa. The water situation in a number of countries there has not yet reached the critical levels of the northern and southern parts of the continent and more immediate priorities, such as the need to increase supply from aquifers in West Africa, and the enhancement of small-scale irrigation in both Eastern and Western Africa, had been clearly identified in the earlier workshop. Therefore, the need for research on demand management may well be perceived as less urgent in these two sub-regions. Nevertheless, there are large parts of the drylands of Western and Eastern Africa that are also suffering from serious water shortages, and they could soon become more common as their economies start growing at a rate sufficiently high to sustain the long-desired rapid economic development of the region. The tough question in this context was to know whether there was a real and urgent need for networking in these two subregions, or if other activities, in particular research activities, should be initiated or strengthened first.

If we assume the need for at least some subregional networks, the question of linkages between them immediately follows. Should we ultimately aim for a single Africa and the Middle East network? Should there be separate but linked networks? Should all address the same research priorities for regional comparison purposes or should each focus on region-specific research priorities? These issues are all discussed in the reports that follow.

Contents of this book

The process leading to the May 1997 "Planning workshop on water demand management research networking in Africa and the Middle East" began about one year earlier when IDRC commissioned four researchers — significantly one each

in North Africa and the Middle East; Western and Central Africa; Eastern Africa; and Southern Africa — to identify research institutions and document research activities on WDM in their respective regions. The executive summaries of these four papers appear as Chapters 1 through 4. To integrate the results from these studies, an overview paper was also commissioned with the further goal of recommending next steps; the executive summary of this report forms Chapter 5.

In addition to the regional reports, two papers — one for North Africa and the Middle East and one for Africa south of the Sahara — were commissioned to identify social issues (particularly as related to gender) stemming from the application of specific WDM options. The executive summaries of these two papers appear as Chapters 7 and 8 below. Chapter 6 is an introduction to gender-based analysis by the regional coordinator. Finally, the keynote presentation on the nature and scope of WDM as a field of study is presented in full as the Introduction. The full versions of all of these papers are available on diskette from IDRC (see Appendix 3).

The main purpose of the workshop was not, however, to listen to prepared papers, but rather to provide an opportunity for researchers from the entire region to discuss ways to move forward in research activities and establish research networks. Therefore, the greater part of its agenda was devoted to a pair of informal, small-group sessions, each lasting half-a-day: one focused on priorities for research, the other on the need for, and design of, research networks. Researchers from North Africa and the Middle East met separately from those from sub-Saharan Africa, as problems and opportunities in the two regions are quite different. Rapporteurs took notes at each of the four small-group sessions, and produced an integrated summary of those results which forms the book's Conclusion. To a very considerable extent, the Conclusion should be seen as close to a consensus document; hence, no attribution of authorship is made.

Appendix 1 lists the participants, while Appendix 2 briefly describes IDRC's program initiative supporting further research on people, land and water in Africa and the Middle East. It is within this program initiative team that most of the decisions on support for further WDM research and networking are likely to be taken. Appendix 3 provides information on how to order the diskette referred to above. A listing of the Acronyms referred to at the workshop completes the book.

In conclusion, it is important to note that IDRC is committed to support the recommendations of this workshop. Some funds have already been set aside for this purpose. However, funds are limited. Water demand management is as large a research topic as it is important. It should be the focus of many researchers and research institutions in the region; and it needs to be supported by many donors in the North.

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Introduction

Water demand management: Conceptual framework and policy implementation

David B. Brooks

Introduction: Water demand and water markets

For many years we believed that water supply was difficult, but water demand quite simple. What passed for demand analysis consisted of projecting growth curves of consumption forward in time as a function of some independent variable such as population (or, in more mathematically sophisticated models, several independent variables). At the risk of irritating many friends and colleagues, I would suggest that we got it backwards. In reality, supply is relatively simple — a matter of working with physical laws of hydrology and engineering principles — whereas demand, which depends on variables linked to human needs and behaviour, and which change over time and space, cannot be so easily constrained.

- Even our terminology for demand is confusing. We refer on different occasions to needs (or basic needs), demands, wants, desires. Indeed, the amount of water needed to satisfy thirst is only a few litres per person-day; the amount needed to grow enough food for that person is 50 times larger; and the amount needed to run something close to a modern economy perhaps 100 times larger. How are we to define demand?

- For most purposes, it is less important to be definitive about the exact definition of demand than to draw lessons from the range of terms. Most important, water is both a physical substance and an economic good, and it is the latter aspect that is most relevant to management and policy. (One can have as much water as desired provided you have the money and the energy to desalinate seawater and ship it to the point of consumption.) Another lesson is that the value of water depends not merely on its quantity but on at least four other factors: quality (see below), reliability, time of availability, and location.

- Markets for water always exist, but are typically obscured by the fact that water is available free or grossly underpriced. Sometimes the markets are visible, as with water vendors in the poorer parts of many cities or with owners of boreholes in rural areas. Sometimes they are hidden, as when governments supply water at more or less subsidized rates. In many cases, water is available "free," but a real cost is incurred (generally by women) in the time and effort to carry it from source to use. In addition, water must go someplace after use, so there is commonly an even less visible price (or cost) for wastewater as well.

- Finally, water is characterized by a uniquely large gap between average price (what a consumer will pay for water in general), which is generally quite high, and marginal price (what that consumer will pay for a bit more water), which is generally not very much. In practical terms, we will pay a lot for a glass of drinking water but practically nothing for another cubic metre of irrigation water.

- Only recently has demand management been recognized as an essential and effective policy tool for Africa and the Middle East. Indeed, in the absence of water demand management (WDM), it will be impossible to satisfy the three goals essential to continued human use of water (and disposal of our wastewater): economic efficiency, social equity, and ecological sustainability.

Perspectives on WDM

Rather than pursuing a definition of water demand, it is more useful to look at three levels of WDM. They range from the relatively mundane (if commonly ignored) level of the individual firm or household, through the more important level of society as a whole, to the truly radical level of questioning common notions of need and consumption.

Firm or household

The water utility, industrial firm, or household can be treated at the same time because they are all individual economic units, and, to one degree or another, all interested in savings. For any of them, water demand management (or demand side management [DSM], as it is typically known by the utility; see Stiles 1996)

is simply a matter of cost-effectiveness: Will investment (of time, money, or effort) in saving water pay off in whatever terms are relevant to that economic unit? Of course, a lot of things may get in the way of making an accurate balance, particularly when water is very low-priced. Also, incentives can be misplaced (from an economic perspective) as when it is women who carry water but men who decide when to invest, or when buildings are charged for water but those rates are not applied to individual offices or apartments. In sum, calculations for the individual firm or household may be complex, but the principle is not.

Society

A much wider set of variables comes into play when we view water demand from the perspective of society as a whole. Concerns here arise because water, which is partially renewable and partially nonrenewable, moves around, crosses (or underlies) boundary lines, and has enormous absorptive capacity. However, when person, community, or firm A uses water, this use affects the ability (or even the possibility) of person, community, or firm B to use water. Therefore, we need social rules to define who can use water, how much, and when. Because all human communities and livelihoods — human life itself — depend on water, equity demands that we have special rules to ensure that everyone can satisfy basic needs for drinking and sanitation. And of course the withdrawal, use, and disposal of water all have environmental effects. Calculations at the level of society are more complex and less definitive than those involving individual economic units. Concepts such as externalities, common property resources, and public goods all come into play, and a large literature has grown up to deal with them.

Soft water paths

Finally, there is the radical perspective that asks: what is the purpose of water use anyway? Modeled on the highly successful approach to energy analysis dubbed "soft energy paths" (Brooks 1995), the theory of soft water paths is still too nascent to discuss extensively at this time. However, we can already see lessons analogous to those we learned from energy. Some of these are listed below.

- Beyond the few litres needed to sustain life, there are many ways to satisfy demands for water. Most relevant to the Middle East, importation of food is an alternative to using water for irrigation (Allen 1996). To be more careful, if the objective is to feed a given population, then use of water to irrigate or use

of money to buy food are equivalent. Obviously, the two options are anything but equivalent in socioeconomic and environmental effects.

- Look beyond the immediate end use to ask about demand management in a larger sense. Drip irrigation may get 90% or more of the water to the plants, but the larger question is whether the water should be used for irrigation at all. One can install low-flow toilets in an isolated village, but the larger question is whether water-based sanitation should be used at all.

- It is almost as important to conserve the quality of water as to conserve quantity. High-quality water can be used for many purposes; low-quality water for only a few. On the other hand, the volume of use that requires high-quality water is rather small, whereas the volume of use that can accept low-quality water is very large. Concretely, we need relatively small amounts of potable water for drinking but large quantities of more or less dirty water for growing food. The importance of quality may also change with technology; turbid water may be perfectly acceptable for flood irrigation but clog the holes in drip irrigation.

- Lines between demand management and supply management get blurred. Is water harvesting a supply or a demand technology? Most analysts have found it convenient to include local sources of supply as part of demand management.

Tools for demand management

Tools and techniques to promote demand management can be classified in many ways but the following four categories are convenient (Rosegrant 1997). None of the measures is as simple as will appear in the list below, even for surface water — and in almost all cases, they are even more complex for underground water.

Institutions and laws

Supply and demand systems for water always exist within a set of water rights, land rights, social and civil institutions, and legal regimes. Some are formal and others informal; some modern and others traditional; some international and others local. They all play a role — more accurately, as great a role as granted to them — as do both modern and traditional institutions for conflict resolution. Few indeed are the societies that do not have some system for granting permanent or temporary rights to use water.

Market-based measures

This is the world of water prices and tariffs, and of water subsidies, both of which appear in a variety of forms. Although pricing is currently touted widely, careful analysts see it as a necessary *but insufficient* incentive for achieving efficiency, equity, and sustainability. Most would argue that subsidies should be explicitly justified; that water tariffs should be designed to encourage conservation, not just to recover costs (which implies that pricing should be high enough to move into the elastic portion of the demand curve); and that some form of lifeline pricing should be adopted to provide water for basic needs of even the poorest household. Of course, any of these measures depends on the existence of a more or less sophisticated system for metering.

Non-market measures

An enormous variety of nonfinancial measures can be considered to promote WDM (Brooks and Peters 1988). Information and consulting services can be provided; social pressure can be applied; regulations can limit the time or quantity of use. Although regulations have a bad name, they are often both appropriate and efficient for managing water demand. Exhortation is also more effective than generally believed, particularly in times of drought. The range of options is wide enough to preclude generalization, but one can say that they should be chosen to support, and if possible reinforce, the effects of market-based measures.

Direct intervention

Governments and water suppliers can, of course, intervene directly by providing services, installing consuming or conserving equipment, fixing leaks, adjusting pressure, providing sewerage, and so on. Publicly funded water and sanitation utilities typically undertake many of these functions. More fundamentally, they can also affect, if not control, land use by their decisions on the location and quality of water and sanitation services, which is of course why these decisions are so politically sensitive.

Dos and don'ts

There are many tasks in WDM, so it may be useful to suggest a few things not to do, or at least to place well down in the priority list.

Don't worry about

- *what will happen in the middle of the next century.* If one projects curves far enough, the world seems to run out of fresh water (Raskin et al. 1996). The relevant time period for water planning is, however, the next two to 20 years, and in that time frame WDM has a lot to offer.

- *the advent of high-capital solutions.* Desalination, water pipelines, and great canals are all on the horizon — which is exactly where they have been for the last 20 years! With the possible exception of some international transport by water and desalination plants in petroleum-producing countries with a lot of residual oil, all of these techniques are too expensive for extensive use in most parts of the world.

- *water demand management in the North America or Europe.* The northern countries are no models of efficient, equitable, or sustainable management of water. In effect, they have used their resources of capital and energy to overcome deplorably bad water management. You *can* learn something about process from North America, where requirements for freedom of information, public participation, and environmental assessment are more extensive than in Africa and the Middle East (Gouldman 1996). Otherwise, conditions in the North are so different that you will have to rely on your own research to develop appropriate methods and measures.

But do think about

- *the* in situ *value of water.* Energy analysts are fond of saying that no one wants energy for itself, but only for the services it can provide. This is not the case with water. For one thing, water provides many services, including habitat for plants and animals, dilution of wastes, and flood stabilization. For another, lakes and rivers are beautiful; springs and waterfalls are sometimes revered. Water has intrinsic value!
- *traditional water management systems.* Older systems, some of which still exist and some of which must be rediscovered, are worth studying. Qanats (or chain wells) have existed for 2000 years or more in many parts of the Middle East and North Africa wherever sloping ground permits fresh water to flow by gravity from higher to lower elevations, but in many places they have

deteriorated or been abandoned because they depend on a high degree of organization for maintenance and allocation of the water. Fresh water used to be harvested in ancient Sidon and Tyre from large springs that emerge under the ocean; those systems also deserve study. The institutions on which such systems were based may have achieved a better balance among efficiency, equity, and ecology than modern systems (Agarwal and Narain 1997).

- *how to allow for extreme events.* Except for fossil aquifers, our water supply is dependent on rainfall, and rainfall is notoriously variable from place to place, from summer to winter, and especially from year to year. A sound system of water demand management must be resilient to extreme events, including both heavy floods and multi-year droughts.

A note on the counter-revolution

Today's serious efforts at water demand management are almost revolutionary. Not surprisingly, therefore, these efforts have spawned a counter-revolution.

This movement is led by the International Irrigation Management Institute (IIMI: Keller et al. 1996; Seckler 1996), and its main point is as follows: water that is not used consumptively cycles back into a basin, and, therefore, what appears to be inefficient at a micro (individual end use) scale may be efficient at a macro (water basin) scale. For example, irrigation water that runs off or sinks to the water table may return to the water course and then be used by farmers downstream. In effect, a water multiplier exists such that every drop of water that does not evaporate or evapotranspire is used several times.

The analysis put forward by IIMI has considerable merit. Moreover, it is not put forward naively: they allow for various kinds of losses of water quantity and quality in the flow back to the river or aquifer. Nevertheless, this analysis can be seriously misleading if used as an excuse not to improve microefficiency or to neglect WDM. Among others, consider the points listed below.

- Effective natural recycling must be proven; it cannot be assumed. It works very well along the Nile in Egypt, which is the source of many case studies. For a variety of geographic and hydrogeological reasons, it works much less well in most other places.

- Over one-fifth of the world's population lives along a coast, so any water they use is lost directly to the sea. Moreover, this is merely a specific case of a more general effect of water flowing to an "economic sink" from which it is simply too expensive to recover (Rosegrant 1997).

- Quality losses can be severe with each use of water, particularly in farming areas where fertilizer and pesticide residues are picked up by the water as it flows over the field.

- Water management costs are highly sensitive to the scale of the system. The less efficient end-use consumption is, the larger both supply and effluent facilities must be. Water-use inefficiency implies an inefficient use of capital.

In summary, even if basin efficiency is greater than farm efficiency in the use of water, this is only true in a physical sense. Thus, we end up where we started — water is at least as much an economic as a physical resource. Natural recycling is not an alternative to demand management. In most cases, conserving water will save both dollars and the environment. It may even allow for more equity as well.

Conclusion

The range of water use patterns in African and Middle Eastern nations is as wide as the range in their economic and ecological conditions. Nevertheless, for all nations, potential gains from attention to water demand management are far from marginal, even for domestic uses (where leakage can be higher than actual consumption). For example, a number of authors have estimated that, in higher-income countries like Israel, 25 to 35% of current water use could be saved with cost-effective measures (Kahana 1991). My own estimates suggest that by including minor changes in lifestyles and in urban and industrial uses, plus some shift away from irrigated agriculture, savings would exceed half of current use. Savings in lower-income countries like those in Eastern Africa would be much smaller, partly because it would be economically efficient to expand irrigated agriculture and partly because the need to provide more water for domestic, urban, and industrial use will overwhelm use-by-use and sector-by-sector savings. Despite differences in current patterns of use, and in prospects for growth in the

near future, it would be economic, social, and ecological folly for any African or Middle Eastern nation to ignore the huge potential of WDM.

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Chapter 1

Water demand management networking in the Middle East and North Africa

Ali Ghezawi

Literature review

The literature review covered published and unpublished sources, including papers, books, proceedings, and research reports produced locally or internationally. These documents were identified by researchers, government officials and other experts involved in water issues that were contacted by the author, who also visited institutions in Syria, Lebanon, Palestine, Egypt, Israel, Tunisia, and Morocco. The literature review produced a comprehensive list of 122 documents related to water demand management (WDM), including full bibliographic citations and abstracts.

Survey of institutions and centres

The study identified a preliminary inventory of all institutions involved in WDM issues in each country of the region. The list includes a brief description of activities as well as names and coordinates of contact persons. This list was completed following site visits to the above-mentioned countries.

A questionnaire was also sent to all institutions included in the above list to seek further information on their WDM activities. Twenty-two institutions responded, and an analysis of the completed questionnaires showed that:

- about 77% of the respondents indicated that WDN was one of their primary areas of research, as compared to 30% for supply management issues and 23% for environmental and other water issues.

Other research foci reported included:

- irrigation performance improvement, holistic monitoring and evaluation (postreview) of irrigation development;
- environment;
- wastewater reuse in industry and irrigation;
- climate change impacts; and
- natural resources.

- Finally, 46% of respondents reported receiving some funding for research from government sources, with a similar percentage receiving funding from international donors, and 31% reporting funding support from universities.

Types of WDM research

The various WDM research activities reported by the survey respondents were grouped into eight WDM research categories (Table 1). The results indicate that current activities related to all categories of WDM research are significantly higher than past activities. Although these figures do not constitute estimates of the actual amount of research conducted, they nevertheless provide a clear indication of substantially increased interest in WDM research. The results in Table 1 also show that current WDM researchers are equally interested in technology development policy and institutional issues. In fact, about 73% of responding institutions are currently involved in research on "development of WDM technologies," whereas about 64% are working on "assessment and development of WDM policy and processes" and a similar percentage on "improvement of intersectoral water allocation."

Current WDM research projects

A comprehensive list of all WDM research projects reported by the 22 respondents is provided below.

- Water supply practices and WDM.
- Use of reclaimed wastewater for irrigation and water recycling in industry.

Table 1. Distribution of water demand management research in the Middle East and North Africa (percentages reported by the 22 respondents).

Types of research	Past	Current	Future
Assessment and development of WDM policy and processes	45.4%	63.6%	45.4%
Development of WDM technologies	27.2%	72.7%	45.4%
Documentation of traditional and modern water management systems	22.7%	50%	45.4%
Improvement of intersectoral water allocation	27.2%	63.6%	54.5%
Development of financial management systems for improved WDM	9%	40.9%	54.5%
Improvement of intersectoral water allocation	27.2%	50%	45.4%
Development of alternative institutional designs for WDM	9%	59%	18.1%
Development of local water supplies to replace central supplies	27.2%	50%	63.6%

- Effect of current water supply practices on drinking water quality.
- Automation of water service systems.
- Institutional management and building capacity.
- Developing courses for basic training in WDM within the Organization of the Islamic Conference (OIC).
- Conservation programs, public awareness, and water quality improvement.
- Tariff studies and determination of the real costs of water services.
- Reduction of water losses and more efficient water use.
- WDM based on efficient uses.
- Water pollution reduction and control.
- Optimal use of marginal water.
- Water policies and strategies to increase the efficiency of irrigation systems.
- Improved hardware and software for irrigation system management.
- Actual crop water requirements.
- Consumptive water use under various conditions.

- Improvement of water-use efficiency.
- Reuse of low-quality water in irrigation.
- Determination of performance criteria and indicators for different irrigation schemes.
- Regional symposium on water use and conservation.
- Integrated water management under the aegis of the United Nations Economic Commission for West Asia (ECWA).
- Irrigation water management.
- The use of treated wastewater in agriculture.
- Allocation by various forms of water markets.
- Reuse of treated wastewater.
- Crop water requirements at various locations.
- WDM strategies for Jordan, Israel, and Palestine.
- Integrated models of water management covering both water supply and demand issues.

Given the high proportion of water used in agriculture, it is not surprising that improving irrigation practices and the reuse of treated wastewater in agriculture are dominating current WDM research work in the region.

Findings and recommendations

General

Irrigated agriculture consumes more than 75% of water resource use in most MENA countries. This fact emphasizes the importance and need for better water management in the agricultural sector, and more specifically, for improved irrigation efficiency. The use of modern irrigation techniques like drip irrigation, together with microsprinklers and other water-saving devices has become widespread in some countries of the region, resulting in substantial water savings. Extensive water savings have also been realized through careful implementation of a variety of on-farm irrigation management practices.

Substantial research is still needed to develop improved irrigation techniques, particularly those adapted for the use of marginal waters, in addition to associated technology transfer activities, which will be essential to further increase irrigation efficiency. Research is also needed to determine the socioeconomic and environmental impacts of these new techniques. And while

it is crucial to improve the performance of agricultural water use, it is equally important to assess the social and political impacts of diverting agricultural water to municipal and industrial (M&I) uses and to assure the adequacy of water quality if irrigation water is to be replaced with treated wastewater.

Demand management is not limited to on-farm measures and practices. Emphasis on appropriate water conservation policies should begin as soon as possible, especially in countries that are not self-sufficient in water. A water official I met on one of my visits said, "Only when we feel threatened by water shortages like you in Jordan will we start thinking about demand management." It is true that supply-side management is more politically attractive than demand management, which is both socially and politically controversial. Nevertheless, a campaign to conserve water needs to be introduced gradually in the region.

The marginal cost of saving one cubic metre of water is far below the cost of producing a new one. Reduction in municipal water-use losses, installation of water-saving devices in homes and gardens, enforcement of water conservation laws, pricing policies, metering, and conservation incentives can all contribute significantly to saving precious water. Public awareness programs can help reinforce the need to conserve water resources.

There is also a need to upgrade and rehabilitate water distribution networks where possible, introduce automatic control systems, develop human resources, and adopt advanced water management techniques.

Private-sector involvement in water resource management is gaining momentum. Unfortunately, there is little information about this aspect among either decision-makers or researchers.

Country-level recommendations

What follows is a survey of water management research activities in a number of MENA countries.

Jordan, with its severe water constraints, can make gains through water demand management and conservation; in addition, it can improve water quality by reducing salinity and pollution. These are the most cost-effective options, and, given the huge expense of the long-distance transfer of water and the slow progress in desalinization technology, they may be the only appropriate options. Improvement of irrigation practices, use of treated wastewater, and rehabilitation and upgrading the M&I networks are a priority. Pricing and metering mechanisms, as well as regulation, are gaining momentum.

Syria seems to be engaged mostly in water resource exploitation activities. The country has ample potential for additional water use and groundwater extraction. However, it needs to consider its stream flow and environmental needs, as well as the possibility that water resource developments in neighbouring countries may considerably reduce the volume of Euphrates River water available to it. This may require a greater focus on WDM and conservation activities.

Egypt has entered into a period of emphasis on limiting water demand and improving water quality. The renewable freshwater supply from the Nile River is already fully exploited and the system is essentially closed. The most promising means for further water development activities involves real conservation (careful attention must be given to reuse of return flows and water quality issues) and water basin-wide system efficiency enhancement, where a considerable number of programs have been undertaken. Reuse of wastewater and attention to actual crop requirements to improve the efficiency of irrigation is essential.

Morocco has some way to go in both water resource research exploitation and WDM/conservation activities. It still has a large potential for water storage development in some river basins. However, momentum is growing on the need for conservation through demand reduction and improved efficiency of water use in other basins. Special attention is being given to integrating water quality and quantity issues as well as collaborative problem solving.

Tunisia has focused its demand management practices mostly on irrigated agriculture. Private-sector participation in introducing modern irrigation techniques is being rewarded by ample subsidies of 60% of the cost. Wastewater reuse in agriculture is also practised.

Israel is carrying on extensive research on water resource demand management, including conservation and recycling, conflict mediation and resolution related to water use and allocation, market-based redistribution, and water demand forecasting, in addition to studies on national water markets, genetic engineering, and agricultural technology. It can play a major role in technology transfer because of its knowledge of modern irrigation techniques and the use of treated wastewater in agriculture.

Yemen is interested in water resource exploitation activities. It has a rapidly growing need for conservation through demand reduction and improved efficiency of water use, and should give special attention to integrating the quality and quantity of its water.

Turkey is conducting research on water resource exploitation. In parts of the country that are self-sufficient in water (have a water surplus), it is studying ways to improve water storage facilities as well as WDM practices.

Palestine is mainly interested in WDM issues and concerns, a result of water shortages and strict Israeli regulations.

Among the MENA countries, which are among the driest regions of the world, it is the author's view that Israel is the leader in WDM practices, with Jordan second.

All of these countries have now entered the WDM development phase, and need to prepare for it well in advance. To shift from water use development (a supply management issue) to WDM they need to resolve the political, social, financial, economical, environmental, and technical issues by devoting considerable effort, thought, and planning (and collaborative problem solving) to it.

A WDM network

A network is needed to develop an information system on WDM-related matters that can be shared nationally and regionally. The aim of this network should be to achieve communication, cooperation, coordination, and collaboration (C4). Ideally, it should assist each country to develop an institutional framework to address WDM issues. It should be an open system, in the sense that it can be modified and further developed by all the countries of the region in cooperation, or individually, with the assistance of IDRC or any interested donors. In this way, the information and experience of other countries could by shared by water experts and planners both locally and regionally.

It is very important to emphasize that the overall goal of the WDM network be to stimulate C4 between the countries of the region on WDM-related issues on the basis of mutual benefits.

An electronic monthly or quarterly newsletter on WDM should be established, with contributions from water experts and researchers in the field.

The role of IDRC and other donors to WDM

To enhance and support WDM activities, the following objectives must be attained with the assistance of the donors.

1. Improved management of the water sector.

2. Implementation of a long-term investment program to improve the efficiency and quality of modern water conservation devices and to expand their adoption.

3. A major program to improve and augment wastewater reuse.

4. Assistance for farmers in the region to develop and adapt to higher-value and less water-intensive cropping patterns.

5 Use of demand management techniques to build efficient, effective, and equitable water use models where these are needed.

To avoid duplication of effort and maximize benefits, the technical and financial support for a WDM network should take into consideration ongoing activities leading to C4 approaches. Strong participation in the MENA region water sector by donors like the United States Agency for International Development (USAID), the German Agency for Technical Cooperation (GTZ), the European Union (EU), and IDRC must be coordinated by a set of mechanisms. Finally, it is very important to establish completely transparent procedures for th WDM network to allow all concerned entities to keep up with current WDM practices and spread their benefits throughout the region by means of an exchange of experiences.

Chapter 2

Water demand management networking in Eastern Africa

Asenath Omwega

A new initiative which aims at supporting policy, institutional, and technical research in order to promote increased efficiency in the use of water resources through the management of water demand in Africa and the Middle East has been proposed by IDRC. The development of an information and research network on water demand management (WDM) is intended to enhance and facilitate this process. The main purpose of this project was to provide an information baseline for possible formation of a regional and international WDM network in dryland areas of Africa and the Middle East which are water-stress areas. This report presents a summary of the findings from the informational baseline survey conducted in the Eastern Africa subregion and covers Kenya, Uganda, Tanzania, Ethiopia, and Eritrea.

The survey indicates that there is a considerable amount of WDM research and interest in the region (Table 1) involving a wide range of institutions — government, non-government and research-cum-training. The most common WDM research areas are related to the development of policy and regulations, development of financial incentives and economic systems and identification of alternative institutional designs for water management. These three categories account for 47% of the 94 studies analyzed. Other WDM research areas where a considerable amount of research has been done are the identification of opportunities for local management of water resources and development of alternative sources of water to replace centrally supplied water. These two account for about 28% of all surveyed cases. The areas with least coverage include documentation of WDM systems, and efforts to improve opportunities for intersectoral and interregional allocations of water, with 5 and 7% respectively.

There is considerable variation in the amount and type of WDM research in the region. Tanzania, Kenya, and Uganda have done more than 70% of WDM activities at the various institutions (an average of 24% per country) as opposed

to 28% for Eritrea and Ethiopia combined. This reflects on the stage of development of water management strategies at the national level, as well as political and economic factors.

Table 1. Institutions carrying on WDM research in Eastern Africa by country and specialty area (numbers in parentheses give percentages of the 93 responses).

Research area	Tanzania	Kenya	Uganda	Eritrea	Ethiopia	Total
Development of policies and regulations which may result in a more equitable, efficient, and sustainable use of water resources	2	3	4	3	2	14 (15%)
Development of water-conserving or water quality preserving technologies and practices	2	3	2	-	2	9 (10%)
Identification and documentation of traditional and also innovative modern systems of WDM	1	2	1	-	-	4 (5%)
Development of financial incentives and economic management systems which can potentially lead to improved management of water demand	4	4	3	3	1	15 (16%)
Efforts to improve opportunities for intersectoral and interregional allocations of water	-	-	2	2	2	6 (7%)
Identification of opportunities for local management of water resources	3	2	5	2	1	13 (14%)
Identification of alternative institutional designs for the management and distribution of jointly held surface and ground water resources	3	3	3	3	3	15 (16%)
Development of alternative local sources of water supply that can replace centrally delivered water	6	3	3	1	-	13 (14%)
Development of databases for water management	1	1	1	1	-	4 (5%)
Total	22 (24%)	21 (23%)	24 (25%)	15 (16%)	11 (12%)	93

The priority WDM research areas in the region from the literature survey and the activities at the surveyed institutions in Table 1 include:

- development of legal and policy frameworks for equitable and efficient management of the water resources at national levels, mainly by ministries and departments responsible for water development and management in these countries;

- development of decentralized water management institutional frameworks at the small-scale level and strategies for increasing the involvement and participation of the local communities (beneficiaries) and the private sector in water management to improve efficiency and conservation; and

- evaluation and improvement of alternative sources and systems of water supply and management such as the rainwater harvesting, small-scale irrigation systems, small-scale water project development, and management by local communities. Research in this area is largely the domain of non-government organizations (NGOs).

Most of the people interviewed during the institutional surveys expressed their interest and need for a network to enable them link up with others, even within their own countries, who are doing research in the same field. This is mainly to share information and promote WDM research, especially the new approaches. This expressed need should, however, be interpreted in the context of the expectations which the researchers might have of IDRC as "donor" and hence the benefits which are likely to accrue from being members of such a network. This should, nevertheless, be balanced with the need to promote WDM research in the region by recognizing that although some WDM research has been done, it is in many cases as part of other objectives and not necessarily deliberate. Actual commitment to support such a network on the part of the institutions surveyed was not determined; however, the interest to participate in such a network was strongly expressed. A number of donor agencies which expressed interest in supporting and participating in the promotion of WDM initiatives in the region were also surveyed. These included UNICEF (Water Units) in Tanzania, Eritrea, Uganda and Ethiopia; overseas development assistance (ODA) in Tanzania; and the United Nations Development Program (UNDP) in Eritrea and Kenya.

A network that focuses on the management of demand for water as a means of improving the efficiency of its utilization — which could help promote the WDM research in the region — is clearly lacking. Two alternatives are proposed here to address this gap: either

- formation of a new network, or
- strengthening the WDM component in the existing networks.

The formation of a new WDM network would require a whole new institutional framework. This could be done through focal centres in each country and regional ones whose selection criteria would include the diverse interests and mandate of the participating institutions and scientists. This option would also need a significant amount of long-term financial support to be sustainable. Institutions already participating in water networks, like the Network for Water and Sanitation International (NETWAS), the Africa Water Network (AWN), and Uganda's Directorate of Water Management, strongly recommended that if a new network is to be introduced, it must have practical linkages with relevant existing water networks.

Existing networks which already directly embrace the WDM goals as part of their mandate are viable options for promoting the WDM research and information exchange. Linking up existing networks has advantages over the formation of a new one, in that the institutional framework for the new network already exists. In any case, some of the institutions which would be members of any new network are already members of existing networks. These include AWN, NETWAS, the Africa Water Group (AWG), and the Global Water Partnership (GWP). Other existing networks should be explored and possible points of entry into any new WDM network identified through discussions with participating institutions and the networks themselves.

Chapter 3

Water demand management in Western Africa

Oumar Tall

Introduction

This study was carried out in two stages:

- a review of current studies, research, and experiments in the field of water demand management (WDM) in Western Africa and the Sahel; and

- visits to several countries in the subregion, including Nigeria, Burkina Faso, the Gambia, and Senegal, and especially to institutions working in WDM, to discover their main research activities and orientations, the quantity and quality of their human resources, and their interest in the establishment of a WDM network.

A bibliography of current studies was made, together with a directory of the main institutions, establishments, and research organizations, as well as a list of researchers active in WDM.

Research activities

Current and future research topics

- Legislation and regulations: water codes.
- Treatment and preservation of water quality.
- The RAGED Project of CREPA (Regional Centre for Low-Cost Drinking Water and Drainage).
- Water conservation and rate setting.

- Several current and future studies by various water distribution companies in the region on costs and billing methods.
- Development and planning of water resources, an environmental plan of action and modeling of aquifers.
- Irrigation impact on water quantity and quality.

A research program on irrigation systems and related themes has been implemented on the regional level in four countries: Mali, Mauritania, Senegal, and Niger. Its main themes include the following:

- farm equipment improvement, cost-effective production techniques, and long-term water and soil resource use;
- maintenance and improvement of soil fertility;
- crop protection against weeds and pests; and
- irrigation management: technical, social and land.

Institutions and researchers

Apart from work done by the subregional development institutions, most of the research presented here was carried out by public bodies such as national water authorities, ministries of water and rural development, and parastatal water management and distribution companies.

Some national agricultural research institutions are cooperating on studies with major research centres. They are currently working hard at restructuring and trying, under extremely difficult circumstances, to carry out their priority long-term research programs.

In general, the major handicap facing the national technical services and research institutions is a lack of material and financial means, as external aid is still the major source of research financing. Unfortunately, external financial backers continue to base project funding support on their own priorities.

Both current and completed research projects show considerable promise.

- The enforcement of legislation and regulations (water codes and decrees on water use) has focused attention on the status of water resources, clarified the rights and obligations of providers and farmers, and helped end the unregulated water use that has prevailed until now. The implementation and enforcement

of those regulations within the framework of the current decentralization will allow a better definition of water resource managers' responsibilities.

- Water planning studies have given countries adequate tools, plans, and master plans for sustainable and equitable management of water through improved awareness of the resources, potentials, and needs. Irrigation research has resulted in better understanding of the hydraulic function of certain parameters and their relationships to water management, including alternatives for the development of ground water, and soil deterioration in some agricultural areas.

- Studies on rate setting have introduced water rates that penalize heavy users and deter waste. Pouvoir Mali (the Mali water and power distribution company) expects substantial water consumption savings when it starts a new system of consumer self-billing by means of special prepaid cards and water meters.

Pertinence of research topics and gaps

Research themes focus on many of the major problems in water management. However, they have not yet dealt adequately with a number of key water management issues of the Sahel, including the four listed below.

- Availability of water resources in fracture zones (fissured aquifers): the studies carried out to date are to be updated with newly collected data.

- Hydrochemistry: research has focused on the treatment and preservation of specific elements of water quality, while geographical distribution of pockets of pollution and mineralization have remained uncertain or described with out-of-date data.

- Intermittent or seasonal surface water: both quantity and quality remain inadequately studied.

- Water rate setting and billing problems: these have not been resolved to the satisfaction of either consumers or managers, particularly at secondary centres where management is communal, and therefore also need to be studied.

To conclude, research in Western Africa and the Sahel has focused on the above aspects of WDM and aquifer studies. However, many projects have yet to be completed; some have not even started.

Feasibility of a WDM network

A technical basis for a WDM network exists in that all the countries of the region currently have modern documentation centres and a bank of computerized data on water use. In addition, there is a large number of competent specialists in the water field (studies, legislation, and management).

Once this network has been established, its research priorities should be the following:

- installation of a harmonized system with standard data collection, storage, and processing and either identical or compatible software used by all member countries;

- specific studies on discontinuous bodies of water and aquifers, including emphasis on water quality through the production of schematic charts (covering the fields of hydrogeology, lithology, chemistry, etc.);

- a study on the performance of hand pumps in rural areas;

- a study on harmonizing the tools of water resource planning at the regional level (plans, master plans, implementation, and enforcement plans) to improve management of transborder water courses;

- an annotated bibliography of current research themes to take advantage of completed studies and avoid duplication; and

- a study on the creation on a communication and information network among the countries of the region, as well as the different regions in each country, to facilitate information exchange and databank update, and link together the different WDM centres of documentation techniques throughout Western Africa and the Sahel.

Chapter 4

A water demand management network for Southern Africa

Simon Forster

The IDRC Dryland Water Management Program Initiative (DWIMPI) has embarked on a water demand management (WDM) networking project for Africa and the Middle East. WDM is defined as any strategy or management action which affects the actual demand that recognized users have for water. The purpose of this project is to (i) conduct a survey of institutions and researchers involved in WDM issues, and (ii) to undertake a critical review of the literature related to these issues. It is then intended to use this information to assess the need for a possible WDM research network, identify the potential resources which could be used, and decide on the best approach to implementing it.

Bibliographical and institutional surveys were conducted throughout Southern Africa. Southern Africa in this context included South Africa, Namibia, Zimbabwe, Botswana, Mozambique, Zambia, and Malawi. Where information and communication was lacking, the surveys were followed up with field visits.

Most of the available literature deals with conservation and recycling of water in various user sectors. Tariffs and pricing, demand forecasting, and competition for water between sectors have received slightly less attention from researchers, although most of the pricing literature is quite recent (from the 1990s) and reflects the growing concern with the cost of water. Education of water users has received reasonable attention in rural areas, and to a lesser extent at an industrial level. However, the education of urban water users seems to have been neglected, a factor which gives some cause for concern, as the region still experiences frequent objections from consumers to paying, or paying a realistic price, for water. Aspects of WDM which have received very little attention include conflict mediation, rationing, market-based redistribution, and consumptive and nonconsumptive demand.

The results of the survey of Southern Africa institutions who agreed to participate are contained in Table 1. A summary of the overall findings is presented below.

1. WDM comprises a variety of measures and instruments which enable water managers to control the demand for water — yet most countries focus on only one or two aspects. Only Namibia, and more recently South Africa, have multifaceted WDM strategies.

2. There is a strong emphasis on pricing policy and water tariff reform prompted, it seems, by the sustainability criteria of financial lending institutions such as the World Bank.

3. A weakness prevails in making consumer education part of tariff reform; this has resulted in poor payment performances and consumer suspicion that the revenue is being put to other uses.

4. Although drought and water scarcity seem to have been the driving force behind most WDM research to date, (resulting in a strong emphasis on conservation strategies) the challenge facing some countries is how to support economic growth within the limitations of their existing water supply infrastructure.

5. Poor investment in water treatment, sanitation, and pollution control throughout the subregion has resulted in an urgent need for cost-effective recycling technologies and ways of using contaminated water safely, thus reducing the demand on limited fresh-water resources.

6. Even though the importance of WDM is generally accepted, governments will still give priority to developing new water supplies if the opportunity arises and financing becomes available.

7. Usable information and training opportunities in WDM are in considerable demand throughout Southern Africa. If one single factor were to separate water supply management from water demand

management, it is the insistence by indigenous water managers that they want to understand, customize, and implement WDM themselves.

8. Obstacles to effective use of WDM in Southern Africa still exist. They include governments impatient to stake a claim to the remaining untapped water resources of the region (i.e., before someone else does), civil engineering consultants who will always feel the need to build something in steel and concrete, and the general failure of the water industry to draw in new skills such as those of economists, social anthropologists, and educators.

9. Southern Africa is fortunate in that it has a solid core of expertise in WDM which is active at all levels from NGOs at a community level to national and regional policymakers. What is required is for these skills to be effectively networked and distributed. There does not seem to be a need for the importation of skills from the developed world at this stage.

Discussions on what WDM entailed led most survey respondents to conclude that they needed access to a great deal more information on the topic and examples of its implementation which they could relate to. There was general agreement that a network for the dissemination of information was a crucial start. But there were also several appeals to support initiatives such as training in WDM, and for South Africa (which is seen as a major source of water expertise in the region) to share its knowledge and skills with its neighbours more readily. One refreshing feature of the responses was the repeated request from water managers to be taught how to implement WDM as opposed to requesting overseas consultants to do it for them.

The following aspects were identified by respondents as issues which should be dealt with by the network:

- pricing policy and tariff revisions;
- minimizing the nonpayment of rates and tariffs;
- consumer education and awareness;
- socioeconomically efficient sectoral water allocations;
- encouraging water reuse and recycling in industry without discouraging investment;
- promoting water-use efficiency and water conservation among irrigators;

- making good use of poor-quality water to alleviate pressure on good-quality water supplies; and
- training of water officials and extension officers in all of the above.

More specifically, a demand exists for the following services and activities:

- *information* which is highly relevant to WDM, is accessible, browsable, readily digestible, and easy to download;
- *training courses* which are short, concise, and offer practical assistance on specific aspects of WDM;
- *conferences and seminars* to promote interest, expose latest developments, and encourage personal contact among practitioners;
- *mentorship* and the identification of specific skills in the region;
- a *bulletin board* reporting WDM related activities and initiatives in Africa; and
- a *clearing house* function for WDM research and development projects requiring funding from the international community.

No other network offers these services at present. Many interviewees also expressed frustration at being isolated from information on WDM techniques and experiences. They know where the information is and where relevant research and implementation is ongoing, but they lack efficient and formal ways of accessing it.

On the issue of the best media for the proposed network there was a high degree of consensus. Most institutions surveyed have e-mail facilities and either have, or are in the process of becoming linked to the Internet. An Internet website is seen as the most appropriate facility for this type of network, even by institutions that are not yet online.

There are three possible considerations for the future site of a WDM information network centre. These are the existence of information management skills, WDM skills, and a high standard of communications infrastructure. From a Southern Africa perspective, the necessary information management and WDM skills can probably be found in Namibia, South Africa, and Zimbabwe. In terms of conventional communications infrastructure, South Africa is the more advanced. However, the use of direct satellite communications for Internet users is starting to be installed at certain institutions. This technology enables Internet

users to bypass the national telecommunications system by using the same technology as used in satellite television. If it is used for a WDM network, the centre of operations could conceivably be located anywhere, provided the necessary skills are on hand to staff it. Given the ease with which information is placed onto the Internet in a user-friendly manner, and the availability of subcontractual skills for Website design and maintenance, the presence of skills in WDM is probably the overriding criterion for selecting an institution to host a network centre.

The problem with using WDM skills as a selection criterion is that many of these skills reside in public institutions without either the mandate or the independence to provide a service of this nature. The University of Natal in South Africa already has an online water information service which might be adaptable for WDM purposes. However, a range of WDM experience also exists in Namibia at institutes like the Desert Research Foundation, which has had a major role in the preparation and dissemination of WDM information to rural Namibians.

The WDM Network will require a manager with good Internet skills, capable of using hypertext programming language, and with a good knowledge of the water sector. This person will need to be supported by 2 to 3 assistants, again with information management skills and a sound knowledge of the water sector. Beyond this, specialist WDM skills should be outsourced, perhaps through some sort of network editorial board, or via an intra-university department collaboration. In order to design, rent, and maintain a Website, collate and prepare information, and ensure a regular flow of up-to-date, relevant information, a budget of between 125 000 and 250 000 United States dollars (USD) per year could be required.

It is unlikely that a network of this nature will ever be self-funding. The cost inputs required to make it a valuable resource to water managers throughout Africa are unlikely to be recouped from the limited number of users and the fees they are likely to pay. It is proposed that grant finance be used to establish the network and support it. Subscriber revenues may be able to meet a significant portion of the long-term maintenance costs, but annual grant contributions will always be required. However, by sharing of the grant finance contribution among several funding institutions and by giving considerations to generating income from sources such as advertising, the individual donor cost burden could be quite small.

The long-term sustainability of a WDM network, then, will depend on the subscribership and usage. It is conceivable that one day the services offered by the network will no longer be required, as Africa's water managers become fully

competent in WDM. However, this is unlikely within the next 20 years. Also, as smaller communities throughout Africa are required to grow within the safe yield of their water supply, more water managers will require the information and services offered by the network.

Table 1. Summary of the Southern Africa institutional WDM survey.

KEY

1 Facilitation, mediation, and conflict resolution
2 Education
3 Competing water-use analysis
4 Pricing and penalties
5 Rationing
6 Market-based redistribution
7 Conservation and recycling
8 Consumptive/non-consumptive demand
9 Demand forecasting

Country and institution	1	2	3	4	5	6	7	8	9
Botswana									
Conservation International			■				■		■
Department of Water Affairs				■					■
Kalahari Conservation Society			■						
Forum on Sustainable Agriculture	■						■		
Mozambique									
ARA-Sul				■					■
Eduardo Mondlane University		■	■				■		■
Institute of Rural Development		■					■		
National Directorate of Water				■					
Namibia									
Windhoek City Engineers Department		■			■		■		■
Desert Research Foundation		■	■				■		■
Economic Policy Research Centre				■					
Design and Development Services		■		■					
UNICEF		■							
Department of Water Affairs		■		■			■		
Malawi									
Concern Universal		■					■		
South Africa									
PRG: University of Natal		■	■				■		
Agricultural Water: Univ. of Stellenbosch		■					■		
Water Research Commission				■			■		■
National Water Conservation Campaign		■		■			■		
Economic Team On Water Pricing			■	■				■	■
Land and Agriculture Policy Centre	■	■	■	■		■	■		
BKS Consulting Engineers								■	■

Chapter 5

Developing a research network for water demand management in Africa and the Middle East

Geoffrey Stiles

Background and objectives

This project is part of IDRC's Dryland Water Management Program Initiative (DWMPI), intended to encourage greater efficiency in the use of water resources through the management of water demand.

The purpose of the current project was to (i) conduct a survey of institutions and researchers involved in water demand management (WDM) issues in dryland areas of Africa and the Middle East (AME) and (ii) undertake a critical review of the literature related to these issues. The project would use this information to:

- assess the need for a possible WDM research network;
- identify the potential resources which could be used to form such a network;
- determine the interest and willingness of researchers to become part of the network; and
- decide on the best approach to implementing it.

The product of the research was a final report, which includes an overview of WDM research in each subregion, a review of priorities in WDM research, an assessment of the feasibility of, and demand for, a research network developed explicitly for WDM researchers, and comments on possible entry points and methods of implementing such a network.

Consultant findings

Consultants were contracted to undertake surveys of WDM research in four main subregions: the Middle East and North Africa (MENA), Eastern Africa, Southern Africa, and Western Africa.

As expected, MENA is a leader in WDM research, with over 77% of reported activities in water research institutions involving some form of WDM work. The most common subjects for research in this subregion are development of WDM technologies (73% of institutions surveyed), assessing and developing WDM policies (64%), and improving intersectoral water allocation (63%).

WDM research in this subregion is highly diversified and focused, with work in the surveyed institutions varying from strategies to improve water use in irrigation systems, through analysis of actual crop water requirements, to studies of the reuse of low-quality water in irrigation.

Involvement in WDM research in Western Africa, Eastern Africa, and Southern Africa is lower, but still significant.

In Eastern Africa, the most common foci of WDM research are policy and regulations, development of financial incentives and economic systems, and identification of alternative institutional designs for water management. These three categories account for 47% of the total of 94 studies analyzed. About 28% of WDM research involves the identification of opportunities for local management of water resources and development of alternative sources of water to replace centrally supplied water.

There is considerable country-to-country variation in the frequency of WDM research in this subregion, with Tanzania, Kenya, and Uganda accounting for more than 70% of the total. As well, a very high proportion of WDM research here is undertaken by NGOs and research institutes, with the result that there is a strong emphasis on small-scale and community-level research.

The main emphases in Eastern Africa include (i) development of legal and policy frameworks for equitable and efficient management of water resources; (ii) development of decentralized water management institutional networks at the small-scale level; (iii) strategies to increase the involvement and participation of local communities (beneficiaries) and the private sector in water management, in order to improve efficiency and conservation; and (iv) evaluation and improvement of alternative sources and systems of water supply and management, like rainwater harvesting, small-scale irrigation systems, small-scale water project development, and management by local communities.

In Southern Africa, WDM research is growing rapidly in importance: indeed, its presence on national political agendas has been enhanced by persistent experience of drought. Although WDM comprises a variety of measures, most countries focus on only one or two aspects. Only Namibia, and more recently South Africa, have multifaceted WDM strategies. Findings suggest a strong emphasis on pricing policy and water tariff reform, education and training, conservation and recycling, and the role of demand management in resolving competing water uses. An important challenge facing many countries in Southern Africa is how to support economic growth within the limitations of existing water supply infrastructures.

In contrast to Eastern Africa, Southern Africa shows a much higher level of research involvement by government and parastatal organizations, and there is a strong emphasis on large-scale, centralized solutions to water management.

In Western Africa, the picture is mixed. While several countries have substantial drylands areas (viz. the Sahel), the region as a whole has fairly good water resources and the emphasis of research is on more efficient allocation of existing resources and development of new supplies. Improving intersectoral allocation of water, documenting traditional forms of water management, and developing financial instruments for water management are the major emphases in WDM research. Western Africa has several prominent research institutions, most of them parastatal in character, and these are likely to be in the forefront of future research efforts.

Significantly, both the MENA and Eastern Africa subregions have already initiated a number of water research networks. In MENA, this is a function of the political and economic significance of water, which is so great that exchanges among water officials and researchers is condoned even where official relations are restricted. In Eastern Africa, it is probably a response to the difficulties experienced by NGOs and small research groups in obtaining up-to-date information on water research.

In Southern and Western Africa, by contrast, there are no existing networks, although several are contemplated and donors are encouraging this development.

The details of existing and planned networks in the region are further discussed below and summarized in Table 1 below.

Despite the wide range of research topics being undertaken, there are still areas which receive less attention that others. These "gaps" are a useful starting point for any effort to identify additional programs of support.

The major research gaps identified include:

- *design of institutions for delivery of WDM programs* (this is a much-neglected area in all regions except MENA.);
- *development of innovative financing mechanisms for introducing demand management schemes*;
- *design and evaluation of small-scale irrigation and community-level water management schemes* which might be attractive as a means of satisfying rural water needs without substantially increasing the cost of supply;
- *improving irrigation efficiency* (both small- and large-scale) through introduction of technical improvements;
- *communication and information systems* required to bring the "message" of WDM to both end users and water agency officials;
- *pricing and tariff policy generally*, including the development of cost-reflective tariffs in particular; and
- *assessment of the socioeconomic benefits and costs of different systems of water allocation.*

It is important to stress that the existence of "gaps" in research should not necessarily serve as a guideline for future research. Some gaps may simply indicate that there is no need for additional work (an example of this might be improvements in irrigation efficiency, which, some would argue, have been thoroughly researched and now lack only the capital to implement them.

The consultants argue that on the basis of their own interviews with WDM researchers, greater attention should also be given to equity and gender issues in particular, community- or small-scale water conservation, especially in the more urbanized countries, and use of demand management as a conflict resolution technique.

International research survey

WDM research internationally is increasingly driven by commercial and financial considerations, and by efforts to privatize or commercialize water delivery — in part because these are the tendencies in the Northern industrial countries which

Table 1. Summary of research activities by subregion.

Type of research	Organizations practising designated research			
	MENA	Western Africa	Eastern Africa	Southern Africa
Assessing/developing WDM policy and process	16	5	5	8
Developing WDM technologies	18	8	4	1
Documenting traditional water management	15	6	7	2
Improving intersectoral water allocation	17	8	4	1
Developing financial management systems	13	6	8	7
Developing alternative institutional designs	16	2	3	3
Developing local water supplies to replace central supplies	16	3	4	0
Rationing and recycling of water	—	—	0	7
Improving irrigation efficiency	—	—	1	1
Developing educational and informational tools	—	—	0	10
Total number of institutions replying to survey	22	10	27	29

provide much of the research money and dominate the major communication networks.

WDM research in the North is itself dominated by the needs of large municipal and regional water utilities, as well as by the development of national and regional water policies. This is evident from the large number of entries dealing with utility-based demand side management (DSM) programs appearing in the literature survey. The research arising from this source is predictably solutions-oriented, and the prior experience of electricity utilities is often introduced as a basis for water dsm programs.

Another major trend is the development of more efficient water use in agriculture. The growing demand for irrigation sources has led, predictably, to an equally strong demand for techniques to reduce water requirements without a drop in productivity, and also to studies of water-efficient crops and cropping systems.

The needs of large-scale commercial farming in semi-arid areas such as southern California are a major driving force for this kind of research.

There is a substantial body of research on regulation and rationing, as well as on the efficacy of different pricing scenarios; and there is an abundance of information on the development of water-efficient end-use technologies such as flow restrictors, drip irrigation, water-efficient waste disposal systems, etc. The results of much of this research are now routinely available on the Internet and the World Wide Web.

The research summary presented in this study is cross-referenced to an international literature survey comprising 180 entries.

Examples of other networks and research support initiatives

Networking as a mechanism to improve the flow of ideas between researchers has a long history, and certainly predates the advent of electronic networking in the 1990s. To illustrate the variety of networking methodologies and objectives, the report includes a brief description of four networks which have been effective and relatively durable: the African Energy Policy Research Network (AFREPREN), the Canadian Policy Research Network (CPRN), the Global Applied Research Network in Water Supply and Sanitation (GARNET), and the Global Rivers Environmental Education Network (GREEN). Following this, a review of different electronic networking options is presented, including electronic mail, news groups, list-servers, registries and project databases, and World Wide Web sites of two different kinds.

In addition to reviewing the status of research in the region and internationally, the project uncovered a number existing networks in AME dedicated primarily to water research. These are set out in Table 2.

Conclusions: Networks

- Several existing water networks (e.g., GARNET and AWN) are now regional or supraregional in scope and could in principle provide the basis for an AME network, although only one of these, AWN, is Africa-based. The Middle East has several networks which operate subregionally and appear to be highly successful in linking researchers in different countries despite political differences and the sensitivity of the subject matter.

Table 2. Existing water networks in Africa and the Middle East.

Name of network	Country	Type of network	Topical focus	Status
Arab Water Information Network (AWIN)	Lebanon	Internet/World Wide Web	Water in general	Active
The Centre for Environment and Development for the Arab Region and Europe (CEDARE) Water Information Network	Egypt	Internet/World Wide Web	Water in relation to environmental development	Active
MENA Economic Summit Waternet	Jordan	Internet/World Wide Web	Water in relation to Arab countries' economic summit process	Active
Regional Water/Land Network	Namibia	Linkage between research groups	Water and land management research	Advanced planning stage
Network for Water and Sanitation International (NETWAS)	Kenya	Resource centre and linkage between research groups	Water management research and implementation	Active and linked to other networks
Africa Water Network (AWN)	Kenya	Information exchange among African NGOs in the water sector	Water research and implementation of all kinds	Active, has e-mail connections to all partners
Inter-Islamic Network on Water Resources Development and Management	Jordan	Information exchange, data bank, research umbrella organization, training institute	Water management research and implementation	Active since 1987, has 12 member states
Global Applied Research Network in Water Supply and Sanitation (GARNET)	United Kingdom	Information exchange, data bank, project inventory	Water and waste disposal	Active, sponsored by ODA., planning to extend mandate and regional reach

- There is no single network which focuses on WDM — subregionally, regionally, or supraregionally — although this subject is certainly covered by panregional networks like AWN and the Arab Water Information Network (AWIN), and also by the planned Southern Africa network being supported by the Swedish International Development Authority (SIDA).

- There is a strong expressed need for a water demand network, which is itself an expression of the imbalance in both the amount and kinds of research being

conducted in the various subregions of Africa. This should not, however, be construed to mean that there is support for such a network, i.e., a willingness to commit local resources.

- All of the subregions have access to electronic forms of networking, although this is a developing, rather than established pattern. The most serious deficiency at present is the inability of many research organizations to access the more powerful modalities of the World Wide Web, and to enjoy the more efficient e-mail communications and conferencing available through commercial providers linked directly to the Internet.

- The potential for networking is undoubtedly greater in the Middle East and North Africa than in sub-Saharan Africa. This is because MENA has a more highly developed research and communications infrastructure, and there is greater similarity both in the kinds of water problems being experienced and in the opportunities for demand management. It may be appropriate, therefore, for MENA to develop its own research network.

- In sub-Saharan Africa, efforts to develop research networks are already in evidence, but developing a regional network specifically for WDM will require additional effort on the part of either IDRC or other organizations. This is so primarily because the three subregions — Western, Eastern, and Southern Africa — have very different kinds of management problems and have already evolved different solutions for them..

- Nevertheless, the very fact that subregional experience is complementary rather than duplicated means that there should be opportunities for exchange of information and discussion of alternative solutions. The simplest approach to developing such a network may be to build on existing networks which already have a clientele. This could mean extending the topical reach of AWN or AWIN to include a specific subnetwork dealing with WDM issues and solutions, or facilitating collaboration between these two networks in developing a WDM subgroup.

- It is clear that IDRC has a potential role to play here as a facilitator and possibly financial supporter. However, this role should be closely integrated with the activities of other donors, and IDRC must avoid supporting the development of a network if there is no complementary support from the

network clients — i.e., a willingness to "buy into" the network, and to sustain it in in the long run.

Conclusions: Research support

Whether IDRC decides to support a network or not, the need to support WDM research in the region will remain. The results of this study suggest that the research areas listed below require additional support.

Design of WDM institutions. Virtually no research has been done on the development of institutions which deal exclusively with WDM, except in South Africa, where the government has created the National Water Conservation Campaign.

- *Development of innovative financing mechanisms.* In North America, and to some extent in Europe, financing of WDM has been strongly influenced by the demand side management (dsm) model originally used by the power utilities. Investigation of alternative financing schemes is a potentially vast area for research, which would provide direct input to donor and lender programs.

- *Assessment of small-scale irrigation and other community-based water management schemes.* Research on this topic is well advanced in Eastern Africa and some parts of Southern Africa (e.g., Zimbabwe), but needs to be encouraged elsewhere in the region. Of particular interest is the development of water marketing and rationing systems at the local level, as well as efforts at rainwater harvesting.

- *Improvement of communication and information systems — the promotion of WDM.* This is an area that tends to be reserved for larger-scale national efforts. Communication and information systems, however, can be equally valuable at the small-scale and local levels, where practitioners may require information on efficient water technologies or cost-based pricing.

- *Pricing and tariff policy.* Identification of the long-run marginal costs of water supply is a necessary precondition for accurate and sustainable pricing of water. Little research has been done on this topic in AME (with the possible exception of Zimbabwe, Namibia and South Africa), despite its prominent role in water management research elsewhere.

- *Evaluation of the socioeconomic gains and losses of WDM programs.* There has been no comprehensive effort to document the gains and losses associated with WDM programs in AME. The screening and evaluation tools used by North American utility-based programs could be beneficially applied to regional WDM programs.

- *Development of WDM as a conflict resolution mechanism for water-supply issues.* This issue is tangential to WDM research but arises out of the competition for limited water resources — which could be alleviated by introducing WDM as an option for communities presently competing for water access.

- *Human resource development (HRD) and skills transfer.* HRD concerns are pivotal to the development of competent WDM research in AME, and transfer of skills within the region is one possible starting point for IDRC support. Enhancing the role of women in water management can be seen as one aspect of skills transfer, although it also requires separate consideration.

Continuing support for these areas is essential if the region is to develop innovative and appropriate solutions to water scarcity — whether through a network, through conventional forms of research sponsorship, or both.

Recommendations

WDM research must be developed further through continued donor and lender support if Africa is to avoid the "trap" of focusing exclusively on supply-side solutions. This is particularly crucial in dryland areas, where crisis situations are common and planners often opt for supply-side projects as an expedient, if short-term, solution. In particular:

- *Research support should focus on aspects of WDM that have been neglected by groups in some dryland areas but are being pursued effectively in others.* In this way, IDRC will encourage intraregional (South-South) transfer of research capacity and findings rather a reliance on Northern expertise. An example of this would be to use Namibia's experience with municipal recycling to drive similar projects in Eastern Africa, or the Middle East's

experience with intersectoral allocation mechanisms, to establish similar mechanisms in Southern Africa.

- *Networking should build on existing networks rather than introduce new ones, or new network forms.* Examples of this might include (i) establishing a regional network which is cross-linked to existing subregional networks, (ii) supplementing an existing subregional network by providing the resources to turn it into a regional network, or (iii) supporting the development of a WDM network which is a subset of an existing regional network.

- *Support for networking should concentrate on developing or improving electronic linkages,* rather than on utilizing traditional nonelectronic forms of networking. This will ensure that Africa keeps pace with networking developments in the rest of the world, and that the full benefits of the Internet are made available to regional researchers.

- *Live conferencing and workshopping should also be supported,* to assist in establishing intraregional ties which could be maintained electronically in the future. IDRC should fund a regional network planning workshop aimed at a core of network participants and research practitioners who would eventually become the "nodes" and system operators of such a network. In addition to finalizing the procedural aspects of the network, the workshop could also serve as a training opportunity.

From IDRC's viewpoint, the potential advantage of developing a WDM research network or networks is that they would serve as more efficient and sensitive platforms for discussion of research needs and for vetting of research projects to peers. It is thus in IDRC's self-interest to promote such a network, while it is also clearly beneficial for the region.

Chapter 6

Gender analysis : What are we looking for?

Eva Rathgeber

Basically gender analysis is focused on a number of practical questions.

The first set of questions relate to efficiency. When we are doing research on development-related topics, it is obvious that we want to ensure that we are putting relevant information into our analysis. To do any less is to create a recipe for failure. In fact we know, after about 45 years of development assistance, that projects do fail regularly. One reason for failure is that for a long time it was assumed that women's perceptions and experiences of development processes were identical to those of men. Even worse, it was sometimes assumed that women did not have any views or perceptions.

We know now that this is not the case. Women do have experiences which are often very different from those of men, and we also know that when their views are ignored, they sometimes sabotage initiatives by refusing to take on extra workloads or by cooperating at only the most tokenistic level. This is hardly surprising, but it suggests that development projects have to be designed realistically to reflect the experiences and perceptions of both women and men.

The second set of questions has to do with equity. Most people would agree that both women and men in all countries have the right to benefit from development processes. To deny women access to schooling or to modern health care or to economic opportunities simply on the basis of sex is not only grossly unfair but also creates a societal drag. If women are not given the opportunity to look after themselves, this will place a greater burden on men or on the state.

So what are the questions we need to ask when we do gender analysis?

Division of labour

- Who does what in the household? On the farm? In the small enterprise?
- Is some work done exclusively by one sex? If so, does this have implications for the capacity of that sex to participate in or benefit from new development strategies?

Decision-making

- Who has access to financial means?
- To what extent are women involved in making decisions at the household level? At the community level? At the national or regional levels?
- Is women's perspective likely to differ from that of men?

Access to resources

- Do women have the same access to resources such as credit, property ownership, training opportunities, education, etc., as men? If not, is this likely to affect the outcome of a development initiative that is dependent on women's participation?
- Do women have access to information?

These are just a few of the questions that can — indeed must — be asked. The more immediate issue is how to pose these questions, and what inferences we can draw from the answers, in the context of water demand management in Africa and the Middle East.

Chapter 7

Social and gender issues in the Middle East and North Africa

Sarah Loza

Introduction

Historically, the economic development of the Middle East and North Africa (MENA) has been influenced strongly by the ability to control water resources and to use them effectively and sustainably. The emergence of the earliest civilizations in the region was the result of the need for a strong, centralized system of government to control and allocate water for the development of irrigation and agriculture.

This paper presents a review of relevant literature and research findings to examine some of the social, and especially gender issues that should be taken into account in the selection and implementation of policy options for water demand management (WDM) in MENA. It also presents a critical overview of two ongoing projects in Egypt as case studies on how social and gender issues have been addressed. The final section of the report identifies social research gaps.

Current situation

A recent World Bank report entitled *Middle East and North Africa Environmental Strategy: Towards Sustainable Development* states that despite substantial economic growth, declines in infant mortality, increases in life expectancy, and improved educational levels, the region continues to face enormous development challenges. Population growth averages 3.1%, which is the highest of any region of the world. Urban population has quadrupled in recent years to 54% of total population. Added to this, the water situation has been described as "precarious" both in quantity and quality.

Ten countries in the region, namely Bahrain, Israel, Jordan, Kuwait, Libya, Oman, Qatar, Saudi Arabia, the United Arab Republic, Yemen, and Palestine (the

West Bank and Gaza) are consuming more than 100% of their renewable water supplies. The degradation of water quality is also a major issue, equivalent to water scarcity in its effect on the economy and health. Untreated domestic and industrial wastewater, and irrigation drainage water affected by overuse of fertilizers and agrochemicals have resulted in the degradation of water supplies.

The World Bank report also addresses the health and economic effects of water scarcity and water quality degradation. Waterborne diseases have been estimated to cause the loss of nearly 8.4 million Disability-Adjusted Life Years (DALY). The per capita DALY loss from waterborne diseases for the region as a whole is second after sub-Saharan Africa. These diseases include diarrhea, dysentery, cholera, typhoid fever, and to a far lesser extent trachoma, hepatitis, schistosomiasis, and intestinal worms.

Scientific achievements and technological breakthroughs in the capacity to control and use water resources have encouraged major new investments in water projects during the 20th century. However, water demand has increased even more rapidly with population and rapid agricultural, urban, and industrial growth. At the same time, the costs of adding to water supplies rise dramatically as the level of water development expands, thus increasing marginal costs of new water supplies. This illustrates the need for a shift in policy toward water demand options. However, the specific water demand options implemented by countries in the region need to be monitored, and their social effects analyzed. In addition, the potential impacts on the main stakeholders must be assessed, and equity issues taken into account.

Strategies for developing approaches for effective women's participation in the planning and implementation of WDM projects need to be investigated through testing procedures with action research and ongoing monitoring and evaluation. Differential patterns of water use by different socioeconomic groups need to be investigated with cost-benefit analysis of leak detection, and repair and installation of water-conserving devices. The findings of such research will support the structuring of equitable block tariffs conducive to water conservation and raise awareness of the technical, economic, and social feasibility of water conservation.

Research and development of water-conserving devices and technologies for domestic and public use as well as irrigated agriculture should be supported for the introduction of models that are technically suitable, cost-effective, and socially accepted.

Conclusion and recommendations for further research

Although the scarcity and quality of water supply in the MENA region necessitates the adoption of prompt and effective policies, strategies, and implemented measures for WDM, technical engineering and economic solutions with limited appreciation and understanding of the needs, concerns, and constraints of users — men as well as women — as viable stakeholders, still dominate.

The limited literature review presented in this paper and the analysis of the two Egyptian efforts to support potable and agricultural WDM have provided evidence to support the recommendations listed below.

- Men and women as water users or managers are differential stakeholders in any water demand policies and procedures. Their differential roles, needs, and concerns should be accommodated in the planning, implementation, and evaluation of strategies and projects.

- Special procedures need to be developed to ensure effective representation of the needs and concerns of women as well as men. Women, and specifically poor women, are faced with gender and class inequalities in terms of access and control of water and financial resources as well as information.

- Institutional, social, and gender issues related to WDM options are far more complex than what is envisioned by engineers and macroeconomists. These issues need to be addressed adequately to achieve equitable and sustainable WDM.

- Water users faced with water shortages, intermittent water supply, low water pressure, poor water quality, and lack of facilities for the disposal of used water, engage in a number of coping strategies that add cost, increase labour, reduce water use efficiency, increase water waste, and affect water quality, as well as decrease food safety. Most of these strategies create greater concerns for women than men, and need to be recognized and addressed by water management agencies.

As a result, there is a great need in the MENA region for systematic gender analysis of the different and complementary roles of men and women in various contexts, and the way they interact to make decisions and share tasks in relation to water management and use at the microlevel. Such research is vital to policymakers and implementors of WDM projects for the promotion of social and gender sensitivity and awareness. Research findings can then be translated into proposals for policy changes to consider both women and men seriously as stakeholders in WDM strategies to ensure equity. There is a need to integrate the gender perspective in all research initiated in support of WDM.

Special efforts need to be directed towards the compilation of research and studies carried out in relation to special projects on a country basis. The literature should be catalogued and mechanisms developed to facilitate circulation and dissemination.

The MENA region is currently experiencing an extreme water scarcity situation caused by high and growing demand. A variety of policy options have been recommended and implemented in an effort to manage water demand so as to increase efficiency of water use among the competing agricultural, industrial, domestic, and navigational sectors.

Chapter 8

Social and gender considerations in water management

Mutsembi Manundu

Introduction

The paper begins with an overview of the current water-use policy in Kenya and covers the following issues:

- targets for coverage (the government had hoped to meet the target of providing safe water for the entire population by the year 2000 — this, clearly, will not be met);
- tariff and metering policy;
- management of equity schemes;
- water demand projection;
- water quality monitoring;
- management of water demand;
- wastewater control;
- water tariff levels;
- water conservation; and
- sanitation.

It then moves into a starting description of gender and water demand management (WDM) issues. Some of the key points include those set out below.

- Women are usually not equal partners when communities create property rights over any resource.

  "It is optimistic to assume that vesting ownership of a water source in the community will give women equal rights over the resource, and far more likely that the creation of ownership rights will confer opportunities for the rich and powerful to appropriate preferential access to the resource."

- As women in Kenya often do not participate equally in decision-making over family expenditures, they are in a disadvantaged position in trying to influence expenditure on options which will reduce the amount of time and labour necessary to collect the family water supply.
  "The 'family' decision may not attach much weight to the aspirations of women to reduce the burden on themselves. This 'family'decision process is almost certain to change over time and there will be a growing desire, at the same income and price levels, to reduce the time and effort spent on gathering water."

The survey

The consultant did a small study at the Yatta irrigation scheme in Machakos District about 90 km from Nairobi. The Yatta Canal is about 60 km in length.

Sample characteristics

- The area has many migrants from outside and relatively high levels of household income.
- There was a total of 66 respondents, 36 (54.5%) women, most aged between 21 and 40.
- 75.8% of the households were headed by men, although data analysis showed that women were the actual economic household heads in almost 35% of the cases.
- Mean household size was 5 to10 people, although one-quarter had more than 11.
- There was a high level of literacy, with 47% of respondents having some secondary education, and only 12% no education at all.
- Women respondents tended to have higher education levels than male respondents.
- Most respondent households owned their land, but in 76% of the cases, the owners were males (reflecting the gender bias in asset ownership).

The findings

- Most users pay for access to irrigation water, but it is a flat rate of about 3.00 USD per year regardless of the amount of water actually used.
- Collecting water from a common point is mostly women's and children's work.
- Most of the households (96%) irrigate their crops.
- The labour associated with irrigation activities was divided as follows: women (44%); men (29%); workers (14%); and children (12%).
- The labour is not arduous, but it is time-consuming, and has to be done about three to four times per week.
- Most people do not have access to an adequate water supply for their irrigation needs.

Decision-making

- Women usually make decisions on domestic water: where it is to be obtained, who will fetch it, how much is to be fetched, and how it is to be conserved (76% women, 21% men, 3% children).

- Women make decisions on general household investments, including minor irrigation work.

- Major investment decisions are made by men on behalf of the household, as with decisions on the purchase of land, cattle and fertilizer, or the rental of tractors. However, in many cases there is some participation by women.

Irrigation activities

- 92% of the households irrigate at night and 85% of them reported that this caused the following problems for women: fear of attack by thugs; exposure to cold in the night; conflict with household commitments such as childcare; and harassment by men.

  "Women who have to irrigate at night complained that men harass them by diverting water illegally to their farms. Women find it difficult to police the water canals to prevent such harassment and are unable to deter

the men except when they catch them. It was reported that such harassment is rarely directed to men, for this would provoke a fight."

- Access to water by livestock was poor, as was access for washing.
  "Since women are the ones who normally do the washing and also the herding of livestock, they are the ones inconvenienced most by the poor design of the water supply system. If women had been consulted during the design stage of the water supply system most of these problems would have been avoided by providing troughs for watering animals and facilities for washing and bathing at convenient spots."

- Women have difficulty making their views known to the local water committees.
  "These problems were: (i) fear of expressing themselves in front of men during meetings of groups that manage the water; (ii) inadequate representation of women on the committees of the water management groups; and (iii) inability of most women to attend meetings because they were too busy with household chores."

- During periods of water shortage (drought) there is competition for scarce resources. Respondents said that those who got the most water were: those closest to the main furrow or canal (24%); the most aggressive individuals and lawbreakers (24%); the wealthy and influential (15%); men (15%). Therefore access to water is not equitable during periods of shortages.

- 99% of those who police the water supply are men and the majority of respondents said these officers were unfair or corrupt. This perception aggravates the lack of equity.

- Women played key roles in seed planting, crop breeding, and carrying agricultural produce to the market, but men shared in keeping the proceeds of the crops.

Group membership

- 83% of the respondents belonged to a water access group.

- Groups tended to have around 50 members and the large size was often a source of water conflict (e.g., illegal water diversion) in times of water shortages.

Analysis

- The flat rates are too low to act as effective means of WDM; but if metered charges were introduced, poor farmers would be disadvantaged and perhaps not be able to afford adequate irrigation for their crops.

- Abstracting of water for irrigation tends to happen at night because priority is given to water for domestic and livestock use.

- Women tend to be disadvantaged because they are reluctant to irrigate at night. Also, since women are grossly under-represented on the water management committees, they have no way of seeking redress.

- The wealthy and powerful are able to influence those who police the system, causing more inequity. They also have undue influence on water management committees and often are able to obtain more abstraction rights than others.

Solutions

- *Decentralization of the control of the water demand management function.* Control should be vested in the community rather than with government officers.

- *Sensitization of the community on the need to mainstream women's participation in water supply design and demand management activities.* Women should be encouraged to attend meetings and vie for leadership positions in the groups. Then meeting times could be changed and women's special circumstances considered when irrigation times are assigned.

- *Entrusting local water management committees with the policing of the water supply system.* This measure would ensure that preference is not given to the wealthiest.

- *The water rates should be changed so that they discourage wasteful use of available water.*

Conclusion

Executive summary

In compliance with the IDRC mandate to improve lives through research and application of knowledge,the Centre sponsored a "Planning workshop on water demand management research networking in Africa and the Middle East" in Cairo, Egypt, May 12-14, 1997.

The two main objectives of the workshop were to identify research gaps in water demand management (WDM) in Africa and the Middle East, and to determine whether there was a need for one or more forms of demand management networks, and how their roles, mandates, and modalities were perceived.

More than 40 specialists and researchers representing different regions of Africa and the Middle East, in addition to representatives of international organizations and IDRC officers gathered at this important forum to discuss the myriad issues related to WDM.

Background

This workshop was built on two other Pan-African IDRC-sponsored workshops addressing water management. The first regional roundtable took place in December 1993 in Cairo. The second Pan-African workshop on water was also held in Cairo in December of the following year. IDRC's aim was to consolidate a Pan-African water research strategy for the sustainable management of freshwater resources in Africa and the Middle East. One of the main recommendations of the workshop was to establish a WDM network.

In light of the water scarcity in many parts of Africa and the Middle East, it was perceived that WDM approaches can contribute to reducing water stress and improving water availability. In addition, there was a general recognition that the research area of WDM was neglected. Therefore, IDRC decided to set for itself the objectives of promoting, advocating and supporting research on WDM and the utilization of research results throughout the region of Africa and the

Middle East. As part of this drive, IDRC solicited the advice and consultations of many researchers and policymakers throughout the continent on the perceived needs to strengthen research in their respective regions. This workshop is considered the most important component of the aforementioned initial consultation.

The workshop

IDRC has commissioned consultants to do institutional and literature surveys on demand management in the four subregions of Africa and the Middle East, namely the Middle East and North Africa (MENA), Eastern Africa, Western Africa, and Southern Africa. Each subregion's main findings and recommendations were presented during the first day of the workshop and were followed by a presentation of a synthesis of all consultants' reports prepared by the project coordinator. These presentations were given on the first day of the workshop to set the stage for the general discussion by providing participants with information on the research priorities in their respective regions as well as initial recommendations on networking needs, capacities, and implementation. In addition, another presentation entitled "Conceptual Framework, Scope and Definition of WDM" was given at the opening session.

The consultants' reports confirmed both the need for WDM research (but at different levels) and for networking in principle. Nevertheless, they also reflected the differences among the subregions in research priorities, networking needs, and modalities.

The reports also identified problems and constraints that can hamper and impede networking, such as access to information, lack of awareness, and difficulty in accessing gray literature. The reports also emphasized the need for training and promoting the knowledge of WDM. Most of the existing networks are focused on water management in general, and not WDM. There is no Pan-African research networking in the region addressing WDM. The reports highlighted the need for networking to ensure an improved flow of expertise, improve communications of research findings, and encourage regional exchange of information.

Research gaps and research areas identified by the program coordinator as areas which require further support are listed below, by subregion.

MENA

- Documenting traditional and innovative water management systems.
- Developing financial systems for WDM.
- Developing local water supplies as an alternative to, or to replace, central water supply systems.

Eastern Africa

- Developing demand management practices and technologies.
- Documenting innovative and traditional water management systems.
- Efforts to improve the intersectoral allocation of water.
- Development of databases for water management.

Southern Africa

- Rationing of water.
- Market-based redistribution of water.
- Consumptive vs. nonconsumptive use of water.
- Mediation and conflict resolution.

Western Africa

- Water tariff setting and billing.
- Studies of water quality, particularly in nonperpetual surface water.
- Development of planning tools for water management.
- Harmonizing of data collection and storage for water management research and implementation.

Overall areas of interest which emerge from these specific gaps are described below.

Documenting or identifying traditional and innovative systems of water management, introducing market aspects to water distribution, pricing and tariffs, management, and regulation of water resources, information transfer, and storage and training.

In addition, IDRC commissioned two other papers: one on the possible impact of WDM options and policies on people, particularly on the poorer segment of the population, including women, and on gender and WDM. These two papers were presented on the first day of the workshop: the first paper addressed MENA, while the second focused on sub-Saharan Africa. These areas have not been given enough attention in research work.

These two papers reflected the need to incorporate gender issues into WDM and recommended that gender analysis and gender documentation be given more room, and that social aspects be taken into account. Women's voices must be heard, as they are critical stakeholders in WDM policies and procedures. Another area suggested by the MENA consultant was to assess the impact of implemented water demand options on stakeholders, both men and women, and to exchange that information with other researchers.

In light of the differences in research priorities, networking needs and modality, the group was split into two subgroups on the second day of the workshop: one dealing with MENA, and the second with sub-Saharan Africa to allow more in-depth discussion and recommendations for the different regions. The second day was dedicated to identifying research priorities and entry points, and on networking aspects. A presentation on the different types of networking, together with an overview of research priorities, were given at the introduction to the concurrent session to pave the way for the other concurrent sessions. The sub-Saharan Africa group decided to split further into subregions to discuss their topics, then presented the findings of their work.

Sub-Saharan Africa

The group has collectively looked at the findings of each subregion and identified areas of commonality. First of all, the group agreed that there were research entry points and research support activities. At some points these two ideas overlap.

Research priorities

- Education and promotion of WDM among users.
- The best technology transfer methods for water conservation and management — this would need collaboration between researchers and policymakers on WDM at the basin, regional, and international levels.
- Data collection and analysis for WDM.
- Documentation of WDM techniques, including local and indigenou techniques, taking into account the geographic extent of the area.
- Evaluation of WDM policies, institutions, tools (i.e. tariffs) and strategy (i.e., privatization).

Specific to Western Africa

- Research on the efficient design and operation of water projects.
- Research on the effective use of a water users' association for efficient use of agricultural water supplies.

Specific to Southern Africa

- Research on institutional restructuring and transformation for WDM (building capacity to help deal with WDM issues).

Networking

Participants reached a consensus that networking was a priority, as there was a need to share information and research findings, and that there was a capacity to set up the network. The required network is a subregional information-sharing type of network with national and Pan-African links, and with a research-oriented outlook. The network should be open to both individuals and institutions, and the differences in needs between countries should be taken into consideration. The electronic media is not the most appropriate type of linkage for sub-Saharan Africa. Thus there is a need to consider information dissemination through publishing documents and holding workshops. There is a need for seed money to start the network. However, it should be structured so that it becomes self-sustainable. More time is required to decide about the host institution for the network.

MENA

Research priorities

- Documentation and evaluation of WDM practices in the region (successes and failures).
- Intra- and intersectoral water reallocation — tools, methods, social and environmental impacts, international comparisons, multistakeholder approaches, uses of gained water and income, user rights, compensation, etc.
- Best options for conservation of irrigation water on the small and large (farm and basin) scale to ensure efficiency, equity, and sustainability, within the framework of a demonstration pilot project using socioeconomic data to complement physical data (needs to be defined).

Networking

The group arrived at a consensus that there was a need for networking among MENA researchers. The required network would be a research-driven electronic type of network that provided open accessibility to both institutions and individuals. Policymakers would be encouraged to join, although joining would not be compulsory. The network would have to be flexible enough to allow for country research emphasis.

The network research findings would be disseminated for the objective of promoting WDM. The network would provide electronically based connectivity with a modality that permitted intercountry and inter-regional linkages between networking researchers as well as between other local, regional, and international networks and other research initiatives in the region. The network could be hosted by IDRC's Cairo-based office. However, there would be a need to hire a qualified coordinator to take over the establishment of the network. It was also suggested that one of the options was to identify multidisciplinary working groups to work either by country or by topic.

Attention was given to the need for sharing experiences and information between MENA and the sub-Saharan groups with the objective of enhancing active interaction between the two geographic regions. This could be done by electronic mail at the present time, with possible occasional meetings between researchers.

It can be concluded that there are some common issues between the two regions, but that the entry points for each would differ. MENA is ready to start formulating a network now, while the sub-Saharan group needs more preparatory work, given the differences in needs, experiences, and research interests among its three subregions.

Throughout the three days of the workshop, participants played an active role in arguing and debating issues and discussing the various aspects related to WDM. Some important points were raised by the participants, including the need to address the recent trend to privatize water services, which is moving quickly in the MENA region, and the importance of delivering information to end users.

Recommendations for follow-up

On the last day of the workshop, agreement was reached on a number of recommendations for follow-up. These are described below for each region.

The sub-Saharan group

In light of the differences between the subregions among the sub-Saharan African group, participants recommended the setup of a working group with representatives from each subregion to formulate a strategy and identify priorities. The subregional working groups would meet within the next three months to follow up on these issues. There would also be a need to meet on a regional basis or at the Pan-African level in six months. There was consensus on the need for working groups, and this is considered a recommendation of the workshop.

The participants proposed to proceed with the identification of the subregional working groups at once. After a short meeting, the group selected the following working group: Lekan Oyebande for Western Africa; Jayant Bhagwan for Southern Africa; and Maurice Ndege for Eastern Africa, in addition to the three original consultants — Asenath Omwega, Simon Forster, and Oumar Tall.

It was also suggested that the African Water Network (AWN) could serve as a focal point of communication and information-sharing within sub-Saharan Africa for the time being. Nevertheless, participants were also expected to take an active role in promoting the network in their respective countries.

The MENA group

IDRC will take the initiative of drafting a proposal on the preliminary agreements reached at the workshop to be circulated to other donors for possible funding. The setting up of a working group for the MENA region was also suggested, to incorporate participants' feedback and comments into the IDRC proposal and for followup purposes.

The MENA group also decided to proceed with the identification of a working group. After a short meeting, it decided to form a provisional steering committee of four — Ali Ghezawi, Khaled Abu-Zeid, Mohamed Matoussi, and Abdulrahman Bamatraf — to coordinate the inputs of the group into the proposal process.

One of the participants from the MENA region, Antun Harik, in his capacity as a Director of the Arab Water Information Network (AWIN) Beirut office, took the initiative to offer to devote a home page on the AWIN Website and post a bulletin board through which participants could share information. Khaled Abu Zeid, Senior Program Assistant of the Centre for Environment and Development for the Arab Region and Europe (CEDARE), Cairo, also offered to send all participants the Website address of CEDARE's Electronic Water Network by e-mail. These initiatives clearly reflect the participants' interest in networking and exchanging information. It was also pointed out that participants could share information by e-mail.

At the end of the workshop, participants commented that this workshop had itself given people the opportunity to link together, and that they had therefore already been networking!

Appendix 1

List of participants

Planning workshop on water demand management research networking in Africa and the Middle East
May 12-14, 1997

Fawzy ABDEL-KADER
Soil and Water Science Department
Faculty of Agriculture
Alexandria University
El-Chatby, Alexandria, Egypt
Tel: 20-3-5961172
Fax: 20-3-5961172

Khaled ABU-ZEID
Senior Water-Resources Program Assistant
CEDARE - Centre for Environment & Development
for Arab Region and Europe
21/23 Giza Street
Nile Tower Building, PO Box 52
Orman, Giza, Egypt
Tel: 20-2-5703473/
5701859/5700979
Fax: 20-2-5703242
E-mail: kabuzeid@cedare.org.eg

Mahmoud ABU-ZEID
President
National Water Research Centre (NWRC)
Fum Teret El Ismailia
Corniche El Nil, Burg Agha Khan,
Cairo, Egypt
Tel: 20-2-220-4360
Fax: 20-2-220-8219

Mohammed AL-HEBSHI
Faculty of Agriculture
Sana'a University
PO Box 22448, Sana'a, Yemen
Tel: 967-1-205295 and
967-1-250937
Fax: 967-1-238784

Aden AW-HASSAN
Coordinator, Dry Land Resource Management Project
Farm Resource Management Program
The International Centre for Agricultural
Research in the Dry Areas (ICARDA)
PO Box 5466,
Aleppo, Syria
Tel: 963-21-213433 - 213477
Fax: 963-21-213490/225105
E-mail: a.aw-hassan@cgnet.com

Abdulrahman M. BAMATRAF
Director General
Agricultural Research & Extension Agency
Authority (AREA)
PO Box 13753
Sana'a, Yemen
Tel: 967-1-218604
Fax: 967-1-218603

Jayant BHAGWAN
Research Manager
Water Research Commission
491, 18th Avenue
Rietfontein
Postal Address: PO Box 895
Pretoria - 0001
South Africa
Tel: 27-12-330-0340
Fax: 27-12-331-2565
E-mail: jbhagwan@wrc.ccwr.co.za

R. M. BRITO
Deputy Dean for Research
Assistant Professor
Faculty of Agronomy and Forest Engineering
Eduardo Mondlane University
CP 257
Maputo, Mozambique
Tel: 258-1-493881/2
Fax: 258-1-492176
E-mail: rui@brito.uem.mz

David B. BROOKS
Chief Scientist
Biodiversity and Equity in Use of Natural Resources
International Development Research Centre
PO Box 8500, Ottawa, Canada
K1G 3H9
Tel: 1-613-236-6163 Ext 2333
Fax: 1-613-567-7748
E-mail:dbrooks@idrc.ca

Ely CAMARA
c/o Mr. Sompo Ceesay
Director General
Sahel Institute
Bamako, Mali
Fax: 223-22-23-76
Tel: 223-22-21-48

Riyad H. EL-KHOUDARY
President
Al Azhar University, Gaza
PO Box 1277
Gaza, Palestine
Tel: 972-7-824010/20
Fax: 972-7-823180

Dia El-Din EL-QUOSY
Director
Civil Engineer, PhD
Water Management Research Institute
Post Code 13621/5, Delta Barrage,
WRC Building,
Cairo, Egypt
Tel: 20-2-218-9563/218-9458
Fax: 20-2-2189561
E-mail: kamer@intouch.com

Aoun Ferjani EL-MEKRAZI
Directeur Général
Direction des Resources Hydrauliques
Ministère de l'Agriculture
Tunis, Tunisie
Tel: 216-1-399320
Fax: 216-1-391549

Naser FARUQUI
Program Officer
International Development Research Centre
PO Box 8500, Ottawa, Canada
K1G 3H9
Tel. (613) 236-6163 Ext 2321
Fax. (613) 567-7748
E-mail: nfaruqui@idrc.ca

Simon FORSTER
Development Planning & Research
PO Box 484 Wits 2050
South Africa
Tel: 339-1172
Fax: 339-1463

Suleiman M. GHEZAWI
Assistant Secretary General
Jordan Valley Authority
Amman, Jordan
Tel: 962-6-689400/410/419
Mobile: 962-7-944487
Fax: 962-6-697902

Ali Zaher GHEZAWI
Director, Administrative
Department
Royal Scientific Society
PO Box 925819
Amman, Jordan
Tel: 962-6-844701
Fax: 962-844806
Mobile: 962-7-926867
E-mail: aghzawi@mars.rss.gov.jo

Jakob GRANIT
First Secretary, Regional Water
Resources
Embassy of Sweden
Pegasus House
52 Samora Machel Avenue
PO Box 4110
Harare, Zimbabwe
Tel: 263-4-790651
Fax: 263-4-754265
E-mail: jakob.granit@sida.se

Tamene GOSSA
Federal Water Policy and Strategy
Development
Project Office
Ministry of Water Resources
PO Box 5744
Addis Ababa
Ehiopia
Tel: 251-1-185275
Fax: 251-1-611700
E-mail: ethnile@padis.gn.apc.org

Antun F. HARIK
Professor
University of St. Efprit
Kaflik - Lebanon
Director
AWIN Network
PO Box 113/6674 Hamra, Beirut,
Lebanon
Farah Bldg., 2nd floor
Sarba, Kaslik, Lebanon
Tel: 09-835063 / 638645
Fax: 961-9-901998
E-mail: water@awin.com.lb, and
awin@dm.net.lb
Internet: http//: www.awin.com.lb

Fawzy M. KISHK
Regional Director
Middle East and North Africa
International Development
Research Centre
3, Amman Square, 5th floor
Dokki, Cairo, Egypt
Tel: 20-2 336-7051/2/3/5
Fax: 20-2 336-7056
E-mail: fkishk@idrc.ca

Wardie LEPPAN
Regional Program Officer
Regional Office for Southern Africa
International Development Research Centre
PO Box 477
WITS 2050
Republic of South Africa
Tel: 27-11-403-3952
Fax: 27-11-403-1417
E-mail: wleppan@idrc.ca

Michael LOEVINSOHN
Senior Officer, Natural Resource Management
International Service for National Agricultural Research (ISNAR)
POBox 93375
2509 AJ
The Hague, Netherlands
Tel: (31) 70-3496100
Fax: (31) 70-381-9677
E-mail: m.loevinsohn@cgnet.com

Sarah LOZA
President
Social Planning, Analysis and Administration Consultants (SPAAC)
21, Ahmed Hishmat Street
Zamalek, Cairo, Egypt
Tel: 20-2-340-8160
Fax: 20-2-340-4338
E-mail: spaac@ritsec1.com.eg

Mohamed S. MATOUSSI
Professor
Faculté des Sciences economiques et de Gestion
Université de Tunis III
Campus Universitaire - Avenue 7 Novembre 1060 Tunis
Tunisie
Tel: 216-1-887512
Fax: 216-1-887512

Lineke J. M. MOURITS
Hydrologist
UNESCO, Cairo Office
8, Abdel Rahman Fahmy Street
Garden City, Cairo 11511, Egypt
Tel: 20-2-354-3036/354-5599
Fax: 20-2-354-5296
E-mail: l.mourits@unseco.org

Mark MUJWAHUZI
Associate Research Professor
Institute of Resource Assessment
PO Box 35097
Dar es Salam, Tanzania
Tel/Fax: 255-51-43393
E-mail: director@ira.udsm.ac.tz

Luis NAVARRO
Team Leader, People, Land and Water Program Initiative
Regional Office for Eastern and Southern Africa
International Development Research Centre
PO Box 62084
Nairobi, Kenya
Tel: 254-2-713160/1, 713273/4, 713355/6
Fax: 254-2-711063
E-mail: lnavarro@idrc.ca

M. NDEGE
African Water Network
PO Box 10538
Nairobi, Kenya
Tel: 254-2-556943/555579
Fax: 254-2-555513
E-mail: awn@ecli.gn.apc.org

Karani OGRETIR
Head of Water Management Research
General Directorate of Rural Services
Koy Hizmetler Arastirma Enstitutsu
PK 35 Eskisehir, Turkey
Tel: (90) 222-237-5700/237-5701
Fax: (90) 222-237-5702

Asenath K. OMWEGA
PO Box 43244
Nairobi, Kenya
Tel:/Fax: 254-2-583381
E-mail: aomwega@arcc.or.ke

Yaw OPOKU-ANKOMAH
Senior Research Scientist
Water Resource Research Institute (CSIR)
PO Box M32
Accra, Ghana
Tel: 233-21-775351
Fax: 233-21-777126

Lekan OYEBANDE
Professor of Hydrology & Water Resources
Department of Planning and Geography
Faculty of Environmental Studies
University of Lagos
PO Box 160
Lagos, Nigeria
Tel: 234-1-821801
Fax: 234-1-822644
E-mail: lekan@infoweb.abs.net

Eglal RACHED
Chief Scientist, Food Security
Regional Office for the Middle East and North Africa
International Development Research Centre
3, Amman Square, 5th floor
Dokki, Cairo, Egypt
Tel:(202) 336-7051/2/3
Fax:(202) 336-7056
E-mail: erached@idrc.ca

Eva RATHGEBER
Coordinator for Africa and the Middle East
Regional Office for Eastern and Southern Africa
International Development Research Centre
PO Box 62084
Nairobi, Kenya
Tel: 254-2-713160/1, 713273/4, 713355/6
Fax: 254-2-711063
E-mail:erathgeb@idrc.ca

Magdeline RAMASIMONG
Marketing Manager
Rand Water Board
PO Box 1127, Johannesburg 2000
South Africa
Tel: 27-11-682-0911 / 6820472
Cell: 082-883-1998
Fax: 27-11-682-0678
E-mail: randw@iafrica.com

Maurice SAADE
Regional Program Officer
Regional Office for the Middle East
and North Africa
International Development
Research Centre
3, Amman Square, 5th floor
Dokki, Cairo, Egypt
Tel:(202) 336-7051/2/3/5
Fax:(202) 336-7056
E-mail: msaade@idrc.ca

Muhammad R. SHATANAWI
Director of Water & Environment
Research
and Study Centre
University of Jordan
Amman, Jordan
Tel: 962-6-843555
Fax: 962-6-830190 / 840150
E-mail: juwater@amra.nic.gov.jo

Olanrewaju B. SMITH
Regional Representative
Regional Office for West and
Central Africa
International Development
Research Centre
PO Box 11007, CD Annexe
Dakar, Senegal
Tel: 221-244231/240920
Fax: 221-253255
E-mail: osmith@idrc.ca

Geoffrey STILES
Manager
SADC Energy Management Project
PO Box 949
Harare, Zimbabwe
Tel: 263-4-735795/791212
Home Tel: 301720
Fax: 263-4-791202
E-mail: gstiles@harare.iafrica.com

El Hadj Oumar TALL
c/o Mr. Sompo Ceesay
Director General
Sahel Institute
Bamako, Mali
Tel: (223) 22-21-48
Fax: (223) 22-37-76

I. ZANDONDA
Liaison/Researcher - Water
Pollution Control
Environmental Council of Zambia
Corner of Suez and Church Roads
PO Box 35131
Lusaka, Zambia
Tel: (260) 1-254130/1
Fax: (260) 1-254164
E-mail: necz@zamnet.zm

Appendix 2

People, land and water: A program initiative of IDRC for Africa and the Middle East

The program initiative **People, Land and Water (PLAW)** is one of the main components of IDRC's effort to support research for development in Africa and the Middle East.

IDRC

Through support for research, IDRC encourages developing countries' own initiatives to find long-term solutions to their pressing development problems. Support is given directly to developing country institutions whose research focuses primarily on helping people meet basic needs, overcoming poverty and inequities, while protecting the environment. The Centre's philosophy is simple — people of developing countries are responsible for and capable of their own development. IDRC's mission is to "*empower through knowledge,*" in which the capacity to conduct research is a necessary condition.

IDRC supports research projects targeted to benefit the poor. Support emphasizes applied rather than basic research. Projects must be designed to maximize the use of local capabilities, including the participation of targeted groups, to strengthen human and institutional capability capacity, and build up self-reliance.

IDRC is mainly funded by the Canadian government. However, it is autonomous in its policies and activities, and its board of governors is international, ensuring the nonpartisan and multicultural nature of the organization. Since its creation in 1970, IDRC has financed about 4000 projects in over 100 countries. It supports various South-South and South-North research networks, and in some cases contributes to development newsletters, international seminars, and conferences. Results from projects supported by IDRC have influenced policies, contributed to technological development, benefited communities, and enhanced research capacity in developing countries.

IDRC focuses the activities of its professional staff on six multidisciplinary themes that are priority for development in the South: *food security; biodiversity conservation; equity in natural resource use; sustainable*

employment; strategies and policies for healthy societies; and information and communication.

The challenge

Millions of people in Africa and the Middle East lack sufficient food and water, and what they have is of poor quality. Continuing soil erosion and loss of fertility contribute to the degradation of this prime resource on which food production depends. The quantity and quality of available water do not satisfy even today's demands. They will fall far short of the needs of tomorrow's population. Improved conservation, allocation, and distribution of soil and water resources is a prerequisite to improved human well-being and security. PLAW addresses these issues.

PLAW's Mission

To help communities in Africa and the Middle East enhance the equitable, sustainable, and productive utilization of land and water resources to improve their quality of life through support for research, research networks, and associated dissemination, utilization, and capacity building

PLAW's objectives

The Program initiative supports research that:

- increases understanding of the systemic factors that lead to the degradation or, conversely, improvement of land and water resources;
- contributes to policies and institutional arrangements that increase access, availability, and quality of land and water resources;
- builds on and improves local coping and adaptive strategies for sustainable production of food and conservation of land;
- develops allocation and conflict resolution strategies for the equitable distribution of land and water resources; and,
- designs tools and strategies that facilitate two-way communication for exchange of information and knowledge on sustainable management, and use of soils and water among policy makers, communities, and researchers.

PLAW's people-centred research

Most problems and opportunities in food and water security are related to how people manage and use the land and water resources they can access. For this reason, PLAW fosters research efforts that engage stakeholders from the start. This research helps to explain how those people interface with their resources and discover feasible and attractive interventions to solve felt problems and to capitalize on perceived opportunities. Interventions may change policies, technologies, or organizations.

During the 1997-2000 period, PLAW will support research on projects that fit into one or more of the above objectives. It will emphasize food and water security, focusing on rural areas and the rural-urban interface within:

- the arid and semi-arid regions of the Middle East and North Africa;
- the subhumid and semi-arid regions of Western and Southern Africa; and
- the highlands and semi-arid regions of Eastern Africa.

Key outputs by the year 2000

While each individual research activity must stand on its own merits, PLAW also expects that the entire set of research projects will contribute collectively to a greatly improved understanding of the issues related to land and water management in Africa and the Middle East. In partnership with researchers and research institutions PLAW expects to produce the following:

- the formulation of methodologies for the analysis of power relations within communities that affect equitable access to utilization of land and water resources;
- a "how-to" manual based on the lessons learned from a variety of sectors and which would include strategies for effective involvement of disadvantaged social groups in comanagement of soil and water resources; the development and spread of improved technologies, policies and institutional arrangements for the management of land and water resources;
- documented reviews of experiences and knowledge in soil management;
- an information clearing house and toolbox on water hyacinth control and management; and finally,

- a research network and an interactive information exchange network on water demand management.

Collaboration and submission of proposals

PLAW welcomes the opportunity to collaborate with like-minded researchers and their affiliated institutions in achieving the foregoing goal, objectives, and products. (Please note that in most cases IDRC support goes to research institutions — including NGOs — and not to individual researchers). Letters of interest, concept papers, and proposals describing relevant research and related activities are invited. To reach us, please contact one of the following:

Canada

PO Box 8500, Ottawa, Ontario
Tel: (1-613) 236-6163
Fax: (1-613) 567-7748
Guy Bessette: E-mail: gbessett@idrc.ca
David Brooks: E-mail: dbrooks@idrc.ca
Galil Elmekki: E-mail: gelmekki@idrc.ca
Don Peden: E-mail: dpeden@idrc.ca

Middle East and North Africa

PO Box 14, Orman, Giza, Cairo, Egypt.
Tel: (202) 336-7051,2,3
Fax: (202) 336-7056
Eglal Rached: E-mail: erached@idrc.ca
Maurice Saade: E-mail: msaade@idrc.ca

Eastern and Southern Africa

P.O. Box 62084, Nairobi, Kenya.
Phone: (254-2) 713160/1, 713273/4, 713355/6
Fax: (254-2) 711063
Luis Navarro: E-mail: lnavarro@idrc.ca
Program Team Leader:
Eva Rathgeber: E-mail: erathgeber@idrc.ca

Western and Central Africa

BP 11007, CD Annexe, Dakar, Senegal.
Tel: (221)244231, 240920
Fax: (221) 253255
Ola Smith: E-mail: osmith@idrc.ca

Southern Africa

PO Box 477, WITS 2050, South Africa
Tel: (27-11) 403-3952
Fax: (27-11) 403-1417
Hartmut Krugmann: Email: hkrugman@idrc.ca
Wardie Leppan: E-mail: wleppan@idrc.ca

Appendix 3

Ordering information for Workshop reports

Full-length copies of the consultant reports described in the chapters of this book are available from IDRC. Please contact:

Diane Languedoc
International Development Research Centre
PO Box 8500
Ottawa, Ontario
Canada K1G 3H9
Tel: 1-613-236-6163, ext. 2552
Fax: 1-613-567-7748
E-mail: dlanguedoc@idrc.ca

Disk contents

Chapter and title	Electronic file name
Introduction: WDM: Conceptual framework and policy implementation	WDM.TLK
1. WDM networking in MENA	FNRPTMENA.DOC
2. WDM networking in Eastern Africa	FNRPT-EA.DOC
3. Rapport finale de l'étude de la gestion de la demande d'eau en Afrique de l'ouest	FNRPT-WA.DOC
4. A WDM network for Southern Africa	FNRPT-SA.DOC
5. Final report of project coordinator	FNRPT51.DOC
6. Gender analysis: What are we looking for?	ANALYSIS.GEN
7. Social and gender issues in MENA	GENDE-ME.DOC
8. Social and gender considerations in water management	GENDER-EA.DOC

To unzip the Workshop documents, please follow the steps listed below:

1) Create a directory on the C drive of your computer with any name, for example, "WATER", as follows:

   C:> md water

2) Copy all files from the floppy disk provided to the WATER directory you created as follows:

   B:> copy *.* C:\water

3) Move to the WATER directory as follows:

   B:> c: — ENTER

   c:> cd water, so your prompt will be:

   C:\water>

4) Type the following command:

   C:\water> pkunzip workshop.zip

5) The original files will be automatically unzipped and created on your water directory.

Acronyms

AFREPREN	African Energy Policy Research Network
AME	Africa and the Middle East
ARA-Sul	Administracao Regional de Aquas do Sol (Southern Regional Water Administration
AREA	Agricultural Research and Extension Agency Authority (Yemen)
AWIN	Arab Water Information Network
AWN	Africa Water Network
BKS	Brunette, Kruger and Stoffberg, Consulting Engineers
CEDARE	Centre for Environment and Development for the Arab Region and Europe
CPRN	Canadian Policy Research Network
CSIR	Water Resource Research Institute (Ghana)
DALY	Disability Adjusted Life Years
DSM	demand side management
DWMPI	Dryland Water Management Program Initiative (IDRC)
ECWA	United Nations Economic Commission for West Asia
EU	European Community
GARNET	Global Applied Research Network in Water Supply and Sanitation
GREEN	Global Rivers Environment Education Network
GTZ	German Agency for Technical Cooperation
HRD	Human Resource Development
ICARDA	International Centre for Agricultural Research in the Dry Areas (Syria)
IDRC	International Development Research Centre
IFPRI	International Food Policy Research Institute (Washington, DC)
IIMI	International Irrigation Management Institute
ISNAR	International Service for National Agricultural Research
M&I	municipal and industrial
MENA	The Middle East and North Africa
NETWAS	Network for Water and Sanitation International
NGOs	Non-government organizations
NWRC	National Water Research Centre (Egypt)
ODA	Overseas development assistance
OIC	Organization of the Islamic Conference

PLAW	People, Land and Water (IDRC initiative)
PRG	Pollution Research Group, University of Natal
SIDA	Swedish International Development Authority
SPAAC	Social Planning, Analysis, and Administrative Consultants (Egypt)
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
USD	United States dollars
WDM	water demand management

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