IRRIGATION, DOMESTIC WATER SUPPLY AND HUMAN HEALTH

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Keywords: Irrigation, water supply, health, multiple uses, Pakistan, Morocco.

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Summary

This paper presents examples of the close interactions, intended or unintended, between the various uses and users of irrigation water. The main focus is on the close link between water used for crop production in irrigated agriculture and water used by humans for drinking and other domestic purposes, a link that has largely been ignored by policy makers, governments, donors, international organizations, and the research community. In addition, a number of reasons are given as to why, from a public health point of view, an exclusive focus on water quality issues is a mistake and why more attention needs to be paid to the availability of sufficient quantities of water for domestic use than at present. The main argument that will be advanced is that significant health opportunities are missed due to the sectoral thinking of professionals and institutions involved in managing water. Several issues are expected to become very important in the twenty-first century and reflect the close linkages between water for food and water for people. These include the overexploitation of groundwater resources

for irrigation, newly emerging groundwater quality problems, and increased recycling of water.

1. Global Water Scarcity

One of the most dramatic changes that is taking place in life support systems is the depletion of fresh water resources. Predictions for the year 2025 show that many countries in Asia and Africa will face an absolute scarcity of fresh water. These countries have no remaining water resources that could be developed and water scarcity will be a major constraint on food production, environmental quality, and human health. Typically, more than 80 percent of fresh water in such countries is currently utilized for irrigation. In order to fulfill the growing domestic and industrial water needs, the only option is to divert water from irrigation to the other sectors. As a result of these water re-allocations, agricultural production will drop and these countries would increasingly depend on imports of food. It has been argued that a "blue revolution" is needed to overcome this water scarcity and safeguard water for agriculture. This would consist of (1) increased use of precision irrigation methods such as sprinkler and drip irrigation to reduce the wastage of water in agriculture, and (2) increased recycling of water.

While the looming fresh water crisis is getting a lot of attention from water resources policy makers and others, the provision of domestic water to rural populations is not seen as a problem in this context. Policy documents on integrated water resources management whether from governments or donor organizations, give first priority to drinking water supply in water allocation decisions and the domestic uses are only a small fraction of the total amount of fresh water utilized in a country. For example in Pakistan per capita water withdrawal for domestic purposes was estimated at 26 m^3 in 1990, against 1226 m^3 for irrigation in the same year. A widely prevalent notion is that a small diversion from the irrigation sector could fulfill the demands of a growing population for domestic water supply. However, in reality this reallocation of water between sectors can be very difficult and a truly integrated water management approach is constrained by the traditional sectoral thinking and priorities set by professionals in the various disciplines. The main concern of public health officials and researchers is the increasing deterioration of water quality due to industrial, agricultural, and urban waste and the insufficient investments in the domestic water supply infrastructure. This global concern for water quality is to a large extent a reflection of the very high quality standards traditionally imposed on drinking water by institutions and professionals in the Western world. Among this group of professionals the supply of high quality water ranks above all and the direct use of surface water such as irrigation supplies seem unacceptable. On the other hand, the managers of water for agricultural production see their responsibilities largely confined to the provision of water in time and space in accordance with plant requirements. Few irrigation managers would see it as part of their mandate to supply water for domestic use. For water planners, domestic uses in rural areas concern only a small fraction of the total amount of fresh water utilized in a country and are therefore easily overlooked. This may lead to the curious situation that high investments have been made to mobilize fresh water into an area, without considering uses other than irrigation. The provision of domestic water to populations in the irrigated areas is then often left to local communities or depends on the initiatives of non-governmental organizations. In this way, poor groups are forced to invest their

limited means in the relatively expensive access to other sources of fresh water, which they will use in low volumes only.

If common priorities have not been established at both river basin and local level between the different sectors, a truly integrated water management approach will not succeed and opportunities will be missed. Technologies to make irrigation canal water or shallow seepage aquifers more suitable for domestic consumption can only be developed through collaboration between the professions. Also, if domestic supplies were given higher priority in the management of irrigation water, significant improvements in the health of communities living in irrigated areas could be obtained.

2. Water and Health

A large part of the disease burden in developing countries is associated with inadequate quantities of safe water for domestic use, lack of facilities to dispose of human feces in a sanitary way, and poor hygiene standards. The most important of the water-associated diseases is diarrhea, which causes high child mortality in many developing countries (Table 1). For low-income communities the conventional approach to improve water supply has been to exploit shallow groundwater with low cost technologies. Adequate sanitation is most often provided using on-site facilities, such as pit latrines.
2.24.4.4.

Disease	Morbidity	Disability, mortality
Diarrheal diseases	1.5 billion new cases per year	5 million deaths per year
Cholera	500 000 new cases per year	20 000 deaths per year
Typhoid fever	500 000 new cases per year	25 000 deaths per year
Roundworm	1.3 billion people infected	10 000 deaths per year
Hookworm	700 million people infected	
Trachoma	146 million people with active infection	6 million people blind

Table 1. The global public health importance of some diseases associated with domestic water supply, sanitation and hygiene behavior.

Contrary to what is often assumed, the quantity of water that people have available for domestic use is of more importance in the transmission of diarrhea than the quality of their drinking water. While diarrhea can be water-borne, for example by drinking contaminated water, other transmission routes especially via food are often more important. Transmission within the household takes place when, for example, there is not enough water for people to wash their hands after defecation, before preparing food. In fact, the safe disposal of fecal material and the adequate washing of hands after contact with adult and child stools have been suggested as the most effective means to reduce the burden of diarrheal disease in children. This emphasizes the overall importance of having sufficient quantities of water available in the household. Lack of water for personal hygiene also maintains the high prevalence of skin infections such as scabies and eye infections such as trachoma. Water related diseases have complex causes with many interrelated factors playing a role in addition to poor water supply, sanitation, and hygiene, the more fundamental ones being poverty and female illiteracy.

3. Improving Water Supply and Sanitation

At the United Nations Conference on Water in 1977 in Mar del Plata the 1980s were declared the International Drinking Water Supply and Sanitation Decade. Initially the difficulty was to persuade the engineering establishment to accept technologies that were appropriate for low-income communities.

Eventually these appropriate technologies were quite widely accepted but in the course of time it became obvious that hardware solutions alone were not enough and that it was necessary to have training, health, and hygiene education, and participation from all segments of the communities including women in operation and management. Even with this in place, progress of implementation was disappointing.

As a result another shift in thinking took place within the water supply and sanitation sector over the last decades of the twentieth century, away from supply-led solutions to a demand responsive approach. This takes the position that where there is a local demand for improved water supply and sanitation, a program will have much more chance of succeeding if it tailors its facilities in terms of cost and service level to local consumer realities.

For the systems to be sustainable the communities themselves would need to contribute with resources to the construction and later to its operation and management. This includes the generation of user fees and the administration of these at the lowest appropriate level.

Water should be seen as a social and economic good with a vital role in the satisfaction of basic human needs, food security, poverty alleviation, and the protection of ecosystems. However, in most of the world water use is not yet guided by economic principles. Irrigation water is largely unpriced and in urban areas the price of drinking water hardly covers the cost of delivery. Subsidies and distorted incentives stimulate wasting of water. Water will have to be perceived as an economic good and as a tradable commodity, although some object to this and say that this will benefit the rich and that the poor already pay a lot.

A minimum supply of safe water is one of the essentials of life and everyone should be entitled to receiving that minimal amount. It is argued that public involvement especially in the management of domestic water will remain necessary.

4. Domestic Use of Irrigation Water

In arid and semi-arid parts of the world with a poor domestic water supply but with relatively abundant water for irrigation, irrigation water from canals, tubewells and small reservoirs can be the only source of drinking water. This will certainly be used if the water has a color, appearance, odor, and taste that is acceptable to the community.
When irrigation water is used directly for human consumption, without any treatment, fecal-orally transmitted diseases such as diarrhea, dysentery, and hepatitis may spread. Eggs or larvae of intestinal parasites are, in the absence of sanitation facilities, often excreted with feces close to irrigation canals, especially when people use water for anal

cleansing. Crops may be contaminated during irrigation or the water may be used further down the system for washing, cooking, and drinking. The fecal contamination of irrigation water can be intentional such as in Indonesia where latrines are often built directly over canals. Generally people do not use this water and prefer groundwater wells for drinking, rivers for laundry, and both for bathing. But contact with this water during land preparation, rice planting, and weeding is inevitable and when wells or rivers are too far away, many people have no other alternative than to use the contaminated canal water for bathing and even drinking.

Irrigation development is often associated with high levels of fertilizer and pesticide use. These agrochemicals applied to field crops may leak into the drains. In some parts of Asia small fish, crabs, and snails that served as a source of nutritious protein to the local population, have now fallen in numbers because of the use of pesticides in upstream irrigation systems. Pesticides may also contaminate the water if the equipment used for spraying or mixing is washed in the canals. When the water is used for animal or human consumption downstream, the low concentrations may still be harmful to health. The chemicals can seldom be removed by cooking and not much is known about their long-term effects. Pesticides are also applied directly into canals, for chemical control of aquatic weeds and occasionally against the intermediate snail hosts of schistosomiasis. The used products are often not very specific and may kill all organic life in the canal system.

There can be a trade off in the domestic use of irrigation water between the potential health risks of using poor quality irrigation water and the potential health benefits of the large amounts of water that can be made available to rural populations through irrigation systems. In addition to health benefits from the higher availability of water, there may be some indirect effects too from the presence of irrigation as such. In areas where separate drinking water supply is available, irrigation canals and structures are often considered more practical for bathing and washing clothes, animals, and household utensils. The wastewater can be returned to the canal instead of soiling mud houses that have no sewerage. Besides that, it is more ergonomic to take laundry and utensils to a canal close by than to carry home large amounts of water. An additional advantage is that irrigation canals and the roads alongside can be used for transportation and thus add to energy savings. With such water-related activities, canals and structures develop into centers of social contacts and the irrigation system becomes part of the human environment the same way that houses do.

As seen in Sri Lanka, the presence of an irrigation system enables people, often women, to divert water to their home gardens. These gardens may have trees bearing nutritious fruit, giving shade, and providing wood for fuel. Livestock rearing, be it cattle, sheep, goats, or chicken may depend directly on water from irrigation systems. In India and Pakistan milk production is significantly better when irrigation water is available than when saline groundwater is the only source.

Water from irrigation canals can also contribute to the development of local economic activities, be it small scale and informal such as butchers, brick making, car washing, or market places, or medium scale with formal water rights such as ice factories in Pakistan. These rural industries may contribute to regional income generation.

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Vision 21 is directed to achieve a world by 2025 in which each person knows the importance of hygiene, and enjoys safe and adequate water and sanitation.]

Biographical Sketches

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