Policy Options for Water, Sanitation, and Hygiene Improvement

B. Natzke
PUBP 758
May 8, 2009

TABLE OF CONTENTS

Abstract **3**
Purpose **4**
Introduction and Background **4**
Definitions of improved sources and access 4
Statistics and importance of issue 5
The environment and water demand – the effect on policy 8
Broader effects – social, economic, and educational 9
Methodology **10**
Results **11**
Environmental issues 11
Right versus economic good; public versus private provision 12
Implications of water as right or public good 14
Worldwide initiatives 15
Role of women 17
Discussion – Policy Options **18**
Water-specific policies 18
Health-specific policies 23
Conclusions **26**
References **28**

ABSTRACT

Disease from inadequate access to safe water, sanitation, and hygiene is a large threat to health, with the risk varying around the world. Each year, an estimated 3.4 million people die due to unsafe water, sanitation, and hygiene related causes, with almost 2 million deaths from diarrheal diseases alone. A large proportion of these deaths occur in the developing world. Even more staggering is the morbidity that is caused by these diseases, with consequences for the economy, education, development, and overall well-being. In addition, environmental influences, access, and water rights have the potential to create international conflict. Policy options, including the training and use of community health workers, are discussed and recommended.

Policy Options for Water, Sanitation, and Hygiene Improvement

Purpose

Increasing access to improved sources of water and sanitation is one of the Millennium Development Goals (MDGs) of the United Nations. This issue has not received as much attention (especially from governments of developing countries) as should be accorded to a cause of massive morbidity and mortality. Some progress has been made on this MDG, but increased efforts are necessary to achieve the goal. This paper examines the background of water, sanitation, and hygiene issues and related policies. It outlines the disease burden that comes from lack of access to improved sources of water and sanitation, demonstrates a need for education and improvement of hygiene, and relates this important health topic to the idea of water rights, environmental quality, and international conflict.

Introduction and Background

Definitions of improved sources and access

The World Health Organization (WHO) uses the following definitions of improved sources of water and sanitation:

> "**Improved drinking water** sources are defined in terms of the types of technology and levels of services that are more likely to provide safe water than unimproved technologies. Improved water sources include household connections, public standpipes, boreholes, protected dug wells, protected springs, and rainwater collections. **Unimproved water sources** are unprotected wells, unprotected springs, vendor-provided water, bottled water (unless water for other uses is available from an improved source) and tanker truck-provided water." (1)

> "**Improved sanitation facilities** are defined in terms of the types of technology and levels of services that are more likely to be sanitary than unimproved technologies. Improved sanitation includes connection to a public sewers, connection to septic systems, pour-flush latrines, simple pit latrines and ventilated improved pit latrines. Not considered as improved sanitation are service or bucket

> latrines (where excreta is manually removed), public latrines and open latrines." (1)

In addition, definitions of access are important background facts and are also provided by WHO:

> "**Reasonable access** is broadly defined as the availability of at least 20 liters per person per day from a source within one kilometer of the user's dwelling. **Sustainable access** has two components with respect to water: one stands for environmental sustainability, the other for functional sustainability. The former insists on environmental protection through limiting extraction of water to a capacity below what is actually available. The latter reflects programme sustainability in terms of supply and management" (1).

Both definitions of access are important when discussing illness burden and policy options (including both health and political implications). The above definitions should be kept in mind throughout the paper.

Statistics and importance of issue

Overall, water, sanitation, and hygiene are important to ideas of health, the environment, and international conflict since

> "there is reason to be concerned for the future microbiological safety of drinking water, in both developing and developed countries. This is because a) source waters continue to received agricultural, industrial, and municipal wastes; b) water treatment and distribution systems age and deteriorate; c) water supplies are overwhelmed by excessive demand; and d) there appears to be an increase in diseases, or at least an increased recognition of disease, caused by pathogens with varying degrees of resistance to treatment and disinfection" (2).

It is critical in developed countries to accurately value water, since in those places water is currently undervalued and the population often holds the false belief that water is an unlimited resource (2). In trying to protect water sources from contamination, issues of the rights of upstream and downstream users arise and costs of wastewater treatment are often high (2).

Access statistics. The WHO 2000 estimate of access reported that large numbers of people worldwide did not have access to safe drinking water (1.1 billion) and adequate sanitation (2.4 billion) (3). However, access statistics can be influenced by issues of accuracy. For example, in India, the official percentage of the urban population that has access to safe drinking water is 90 percent (3). The definition of access used in creating these numbers may not take into account the fact water may only be available during certain hours and in certain parts of the city. In addition, the distribution system may make access look good on paper (with piping available), but water pressure may be low in the pipes at the end of the system, which affects both quantity and quality of the water. People living in informal settlements often lack access to water through public arrangements and resort to other solutions such as storing water at home or purchasing water from local entrepreneurs or NGOs. Therefore, there are still problems even when people are reported to have "access."

Illness, morbidity, and mortality burden. The WHO estimates that 3.4 million people die each year from issues related to unsafe water, sanitation, and hygiene, with most of these deaths occurring in children (4). One study of the global disease burden estimated

> "the disease burden from water, sanitation, and hygiene to be 4.0% of all deaths and 5.7% of the total disease burden (in DALYs) occurring worldwide, taking into account diarrheal diseases, schistosomiasis, trachoma, ascariasis, trichuriasis, and hookworm diseases. Because we based these estimates mainly on intervention studies, this burden is largely preventable. […] This significant and avoidable burden suggests that it should be a priority for public health policy" (5).

The extent of morbidity and mortality from illnesses related to water, sanitation, and hygiene varies greatly around the world. Developing countries have higher amounts of

illness (and morbidity and mortality) from water, sanitation, and hygiene related causes than developed countries. (One estimate of the disease burden is that it is up to 240 times higher in developing regions than in developed (5).) In addition, Africa and Asia bear much of the burden. These diseases disproportionately affect the poor due to complex and interconnected reasons, including the malnutrition that often occurs among the poor and the fact that the wealthy have better access to services and often live in less polluted environments (5).

There are a number of interrelated pathways for transmission that may cause disease due to unsafe water, sanitation, and hygiene (5). These transmission routes are varied and can be complex: human and animal excreta through drinking water, food, sewage, or indirect contact; drinking or using water contaminated by pathogens or chemicals; lack of water for personal hygiene use (for example trachoma and scabies from inadequate washing); poor hygiene in general (personal – person-to-person transmission, domestic – food borne illness or contaminated water used for cleaning, or agricultural – contaminated water used for irrigation); or from vectors in water reservoirs or stagnant water (5).

Illnesses from unsafe water, sanitation, and hygiene are especially serious for children. For example, diarrheal diseases are often related to these environmental factors and affect mostly young children (86 percent) (6). Illness affects motor and cognitive development and growth (7). The malnutrition and other negative effects from diarrheal diseases (especially when they occur repeatedly) in the first two years of life can create long-term development impairment. This creates morbidity that is increasing and very costly in terms of human losses, along with microbiological, economic, and

developmental implications (7). Oral Rehydration Therapy (ORT) has been able to reduce mortality caused by acute dehydrating diarrheal diseases, but morbidity is still a large problem due to these developmental impacts (7).

Types of illnesses. Many diseases are related to unsafe water, sanitation, and hygiene. Infectious diarrhea (including diseases such as cholera and dysentery (8)) accounts for much of the disease burden (5), and WHO estimates that 88 percent of diarrheal diseases are related to poor water, sanitation, and hygiene (9). Other illnesses that can be related to unsafe water, sanitation, and hygiene include: schistosomiasis, trachoma, intestinal helminthes (ascariasis, trichuriasis, and hookworm), Japanese enceptalitis, and hepatitis A (9). Schistosomiasis, cholera, and typhoid fever are among the most deadly waterborne diseases (10).

The environment and water demand – the effect on policy

The environment and water demand will influence both the diseases from unsafe water, sanitation, and hygiene, and the policy options chosen to address this health issue. Increases in population and an increased demand for water for irrigation leads to an increased pressure on water resources (11). Changing socioeconomic situations can influence changes in water use, such as when pastoralists move to agriculture (or switch crops) which causes an increase in demand for water for irrigation (11). In the Mount Kenya region, "the allocation of the available water resources is a key problem in the region and has repeatedly led to open conflicts between upstream and downstream users" (11). Water policy is influenced by context: "a wide variety of different stakeholders with different interests, highland-lowland interdependence, unequally distributed natural resources, unreliable rainfall patterns and quantities, decreasing river discharge during

low flow periods, conflicts between upstream and downstream users" (11). These factors, as well as political situations, need to be taken into account in policy creation. Different stakeholders will have different interests, and policymakers need to handle the competing interests. In creating policy to increase access to water and sanitation, these competing interests and the effects any interventions will have on populations outside of the intervention population need to be anticipated and taken into account for the policies to be successful and not create further regional instability.

Environmental quality will also influence the policies that are created to improve access to water and sanitation. For example, China has industrialized and urbanized, but has not invested adequately in infrastructure for basic water supply and treatment, which has created water pollution (12). Now, over half of the Chinese population drinks water that is contaminated with animal and human excreta that exceeds maximum levels permitted (12).

In addition, water supply concerns intensify the debate over policy options on how to use this resource. Water is used for drinking, irrigation, industry, waste disposal, etc. (13), and these multiple needs may influence how water is allocated. When evaluating policy options, one needs to take scarcity and future concerns, including population increase, into account.

Broader effects – social, economic, and educational

Lack of access to safe water, sanitation, and hygiene also has effects beyond direct health implications. Female education can be negatively affected. Females may spend so much time carrying water because the water source is far from their home that they do not have enough time for education. In addition, they may avoid school due to

lack of sanitation at the school, something that is an especially sensitive subject once they begin menstruating. This perpetuates female/male inequality that exists throughout the world. In addition, due to lost work days from illness (either feeling ill oneself or needing to take care of an ill family member), productivity is less than it potentially could be. Safe water and sanitation are linked to broader poverty reduction through pathways such as improved livelihoods and education (8).

Overall, there are many implications of lack of safe water, sanitation, and hygiene. In water policy, challenges exist in the form of supply, distribution, and use, such as internal distribution, poor quality water, and pollution (14). These challenges will be further explored through discussion of the findings of the literature review and policy options.

Methodology

A literature review was conducted as the basis of this paper. Journal articles, reports, and books form the evidence to support the argument and policy recommendations. Key terms such as “water and health,” “water public health,” “access to water,” “sanitation,” “sanitation and health,” and “hygiene and health” were used to search various databases. The search on “hygiene and health” returned large amounts of unrelated information, so the search was modified to also include the term “developing countries.” Many of the journal articles were accessed through JStor, while a few were added from an EBSCOhost search of the following databases: Academic Search Premier, EconoLit, ERIC, and NHS Economic Evaluation Database. A search of Aladin, the library catalog that includes consortium schools such as George Mason University and George Washington University, concluded the database review.

The WHO website was also accessed. This site has data on illnesses from unsafe water, sanitation, and hygiene, as well as information about the disease burden throughout the world. Basic disease information and statistics in other sources were often gathered from WHO, so the WHO website was deemed a reliable source of quality information.

Timeliness and relevance were the criteria used to select the literature for inclusion in this paper. In general, sources were limited to those produced after 1990 to ensure that the information was recent and accurate. This was especially a concern for developing countries, where political, social, or economic changes, including development efforts, may have affected the accuracy of information in older sources.

After much of the literature search and review was completed, newly found sources often did not add much new information. At that point, the search was considered complete. When writing the paper, timeliness, relevance, and a source's ability to add new information or ideas to the discussion affected inclusion of the source as a reference. Literature is reviewed below, and policy recommendations follow.

Results

Environmental issues

Environmental degradation and increasing problems associated with urban growth threaten the gains that have been made due to public health. Development and the environment are in a cyclical relationship. "In cities, increased congestion, industrial expansion, and lack of pollution control result in unhealthy levels of pollutants in air and water. Environmental stress is the price of development" (15). Development harms the environment, which in turn harms further development. In at least one country, Nigeria,

many people have negative attitudes toward the environment and do not place much value on individual or environmental sanitation, despite government programs to address the environment (15). An attitude change needs to happen in these places, and sanitation and environmental education has been proposed as part of a long-term method to decrease health problems related to these issues (15). In places with high levels of illiteracy, education can be problematic as a policy option. Mass media and public enlightenment campaigns can be used to promote sanitation (15). In Nigeria, a study found that more knowledge lead to better attitudes about personal and environmental sanitation (15), which may create behavior change.

Ebong (15) recommended the following strategies for improving sanitation:

1. Governments should develop strategies to educate people on the importance of environmental sanitation and sustainability.
2. Efforts should be made to organize seminars for health workers to effectively educate the general population on programs for a sustainable healthful environment.
3. The government should establish environmental health policies to reduce environmental degradation and pollution.
4. The government should develop programs and provide facilities so that garbage and waste can safely be removed from homes and streets.

Right versus economic good; public versus private provision

These four options promoted by Ebong relate to what the government should do. Other authors emphasize private efforts. In the literature, a debate about the correct role of public versus private organizations in the provision of water and sanitation and in managing water resources persisted. Two ideas strongly influence this argument: “water

as an economic good, which privileges notions such as ‘full cost recovery’ and ‘user pay’; and water as a human right, which implies that all people should have access to water regardless of their ability to pay” (16). Even when narrowed down to one region, the debate is fierce. One author thinks that subjecting water resources to the market will weaken important reforms in Africa (16). On the opposite end of the debate is South Africa. Around 1999, South African politicians changed policy from “direct provision by the state to the rural poor, to acceptance that outright privatization is the possible solution to the problems of water delivery” (17).

One author notes that theory and evidence do not conclusively support private or public ownership as best (18). He proposes that drinking water and wastewater treatment are natural monopolies and as such will usually be provided by one organization (18). Since there will not be competition, the benefits of private ownership will not occur (18). Private organizations do have the advantage of being more successful in raising money for investment (18), which is very important in the development and maintenance of systems for providing water and sanitation. However, some believe that using market solutions undermine provision of water and sanitation services and negatively affect the poorest and most vulnerable populations (19). Another author says that just because there are public benefits to an intervention does not mean that it should be supported by public resources (20). This author separates concerns with equity from the efficiency decision of public versus private provision. In creating a framework for policy decision, policy-makers must decide if a purely economic view will be taken. This links back to the idea of water as a right versus and economic good. If water is a right, then the purely economic view may not be sufficient to achieve that right.

Currently, private water vendors deliver water to many urban poor in the global South using jerrycans or tankers and charging a much higher price per volume compared to water accessible to the middle or upper classes from public water systems (3). In the twentieth century, many industrialized countries have moved to public water supply provision due to multiple reasons:

> "In addition to water's 'natural monopoly' characteristics, the symbolic and cultural importance of water as a (partially) non-substitutable resource essential for life, its strategic political and territorial importance, the intense conflicts that arise over the shared use of a flow resource required to fulfill multiple functions (agriculture, industrial, drinking water, environmental), and the need in industrialized, urbanized societies to mobilize large volumes – invariably at a high cost relative to the economic value generated – have been used, particularly in the twentieth century, to justify public sector involvement. Moreover, the health and hygiene effects of lack of access to water, together with the tendency of private companies to fail to extend coverage to the poor (both as a result of the tendency to cherry-pick profitable neighborhoods and classes of consumers, and the high prices and poor services resulting in a situation of natural monopoly), were two of the most important justifications for bringing water supply under the control of the state, whether through strict regulation or public ownership of water supply infrastructure during the twentieth century" (3).

The private sector has been involved in many forms, however, including construction, management, and extension of supply networks (3).

Implications of water as right or public good

As noted above, the current policy framework is influenced by the idea of water as a right. In November 2002, the "United Nations Committee on Economic, Social, and Cultural Rights adopted a formal acknowledgement of the human right to water that sets forth general criteria for universal enjoyment of the right" (4). In some cases, the idea of water as a right is legislated. The South African Constitution includes access to water as a right, and the Water Services Act, 1997, proposes to "ensure and define the rights of access to basic water supply and basic sanitation services" (17). The Reconstruction and

Development Programme of 1994 pledged to "provide 25 liters per person from a standpipe within 200 meters" (17).

The framework of right versus economic good creates the governmental role in water provision. If water is treated as a human right, and is legislated, then governments would have the responsibility of ensuring the right (3). However, if water is treated as an economic good, then there is no responsibility on the government (3). It is possible, though, that in "ensuring the right," the government could leave it up to the market, while monitoring access and stepping in where private organizations do not provide sufficient volume. Even in treating water as a right, there are difficulties in implementing that right. For example, in South Africa, even though water is a right through the Constitution, many citizens still do not have access to the minimum outlined in legislation (3).

Worldwide initiatives

There are major worldwide initiatives to increase access to water and sanitation. The Millennium Development Goals (MDGs) were created in 2000 by the United Nations. The MDG related to water and sanitation set the goal of "decreasing by half the number of people without sustainable access to drinking water by 2015" (4). To achieve this goal, the rate of progress needs to be dramatically improved. In 2002, it was estimated that to meet the water and sanitation MDG targets, per day until 2015 an additional 260,000 people need to gain access to improved water sources and 370,000 people need to gain access to improved sanitation (9). This is a daunting challenge. Oxfam International has negatively assessed progress toward meeting water and sanitation MDG targets. For example, they calculated that given the current progress, the goal will not be met in Africa until 2105 (19). The percentage of the global population

with basic sanitation was about 35 percent in 1990, approximately 50 percent in 2004, and the goal for 2015 is just under 70 percent (21). While these statistics show the progress that has been made, it does not show that there is much variation across countries in access to water and sanitation. This is particularly true for developing countries. In 2000, there were nine countries where less than 20 percent of the population had access to sanitation, 26 countries where access was between 20 and 40 percent, 35 countries with 40 to 60 percent, and 26 countries with 60 to 80 percent (22). The distribution for access to water was similar: one country had less than 20 percent of the population covered, while six countries had 20 to 40 percent, 24 had 40 to 60 percent, and 35 had 60 to 80 percent (22).

There is an issue with the statistics that measure progress. For example, wells may be set up but not actually used or maintained, and they may still count as access even though the community members do not really have access as the MDG intended. Projects in South Africa, for instance, reportedly have a high failure rate, so the launch of a program is different than sustained delivery or operation. The South African standard of 25 liters per person per day through standpipes at least within 200 meters of walking distance is supposed to make access to water convenient in rural areas (17). However, women, whose are traditionally responsible for water collection, often struggle to make enough trips to the standpipes with the heavy containers in steep areas (17). Therefore, they are unlikely to make enough trips that would provide per capita consumption to meet the standard that would support health (17). So, even with "access," there are health implications of not consuming enough water.

As a follow up to the MDGs, as of June 2003, WHO is leading a network of development agencies, research centers, NGOs, and others, called the International Network to Promote Safe Household Water Treatment and Storage (4). The goal of the network is to “promote simple, low-cost, point-of-use approaches to rapidly increase access to safe water supplies and sanitation services for less-affluent populations” (4), which will include promoting independent research regarding issues such as cost-effectiveness and health impact (4). With the creation of this network, the policy framework for access to water and sanitation changed from a focus on community-based projects to household-based projects (4). The network is guided by the following principles: “involving communities and individuals in developing appropriate water and sanitation improvement strategies, recognizing the role of women in managing household water supplies, and promoting local technologies, resources, and capacity building” (4). The United Nations is also focusing on water by declaring 2005-2015 the Water for Life decade (9).

Role of women

Women were targeted as beneficiaries of South Africa’s Reconstruction and Development Programme, “both in terms of representation on water project steering committees and through easing the burden placed on them in rural areas to provide water to their households” (17). This is one example of a country that has included gender policy in its water and sanitation policy. Mjoli, as cited in Hemson (17), argued that “water and sanitation projects are more sustainable when women have ongoing responsibility for their operations and maintenance as they are more committed since they are adversely affected by project failure. Water policies thus have to have a gender-based

approached to ensure sustainability." This points to the major role that women should have in projects. "Over 75 percent of the very poor households are Africa households in rural areas and most are headed by women. Rural mothers (and grandmothers), and their daughters invariably take exclusive responsibility for bringing water to the family and for family health" (17). Hours per day are spent on water and fuel collection, which is linked to the effect on women's education, and the education and economic opportunity costs of needing to spend their time in this way. Several trips to water sources (potentially through unsafe areas) adds up to many hours spent on this task and many miles walked (for example, rural African women often walk as much as 10 miles every day to collect water) (8). Rural women often benefit the most from access to clean water and sanitation, especially when it is close to their homes. Aside from the positive effect on family health, they have more time for other activities, including childcare, cooking, earning an income, education, and new pursuits (17).

However, there are social implications in this access. It may be seen as a threat to patriarchy, and some men do not appreciate the benefits, and even resort to sabotage of water pipes, since it decreases the men's control over women's labor and threatens the established order (17). To aid women, empowerment strategies are useful, such as including women in planning and operations, decision-making and management (17). Gendered approaches to the provision of water and sanitation need to be part of policies.

Discussion - Policy Options

Water-specific policies

To aid with water resources conflict, organizations can provide support for stakeholders' concerns. A case study of water shortage in an area of Kenya proposed

Water Users' Associations to mitigate conflict. These Associations are self-help ways to deal with allocation of water by providing timely information about demand, supply and use of water (particularly river water), and also by providing methods to improve management of water (11). In catchment areas near the Mount Kenya region, Water Users' Associations have proved successful when allocating water resources and diminishing conflict (11).

Improvement of efficiency is an important policy. Due to the increasing population and increasing demand for water, efficiency is the basis of any intervention in both developing and developed countries. Efficiency could be improved through new technologies, including drip irrigation in agriculture (11), economic incentives, and better valuation of water (13).

In addition, demand management is important, especially in developed countries. Policy options to reduce demand include water use regulations (such as alternate day watering and building codes requiring conservation fixtures), education, and pricing (23). Well-planned pricing schemes can aid in cost recovery of building and running the water or sanitation system as well as encourage conservative use of water (18). However, one may run into issues reconciling pricing schemes with the idea of water as a basic need regardless of socioeconomic status. One way to manage this is to provide a certain volume of water per person per day free or at low cost, then increase the price for higher consumption. These pricing schemes would need to be well-designed to ensure that a balance is struck between encouraging conservation of water and ensuring that people have access to and use enough water to support hygiene as well as drinking, cooking, and sanitation needs. In order to have enough water to provide access to safe water and

sanitation (upon which hygiene depends), and to prevent conflict over water resources, increased efficiency and lowered demand are necessary. While these policies may seem peripheral to the health policies needed for reducing disease related to water, sanitation, and hygiene, they form the basis of the type of comprehensive policies that will be necessary to reduce this disease burden.

Specific interventions for developing countries include things like point-of-use disinfection, home chlorination of drinking water, and piped water where feasible (or as the end goal, with more basic home-based strategies improving health until modern systems can be funded, planned, and executed). In addition, education campaigns about basics like hand washing have the potential for large impact (but is also dependent upon access to water that is safe and abundant and close enough to support this behavior change). There is evidence that much improvement in health can come from simple interventions such as safe storage of drinking water and disinfection at home (5).

Pollution control and prevention is important in maintaining water quality once access is provided. In both developed and developing countries, contamination comes from human activities such as agriculture, industry, hazardous waste, development of residential sites, and transportation (18). Countries may ensure the safety of the water they provide to their citizens and also the safety of the water that is used by other countries, since water is not bound by political borders. Treating water as a precious resource may help to mitigate potential conflict over water since one country will not be contaminating water that another country uses and depends upon. In addition, filtration and disinfection is important and technologies can protect quality. Filtration and

disinfection should be part of water supply management. In the United States, chlorine species are the most common disinfection agent (18).

Infrastructure will need to be built up and maintained to provide access to safe water and sanitation. Water and sewer infrastructure is very capital-intensive, but properly planned and maintained, may have fairly long provision lives (3). This makes creation of new systems seem more cost-effective; however, expanding, updating, and maintaining existing networks to provide higher quality water to existing users and access to new users may be problematic (3). In addition, if the planning and building is done where there are weak institutions, it may be difficult to obtain permits to build infrastructure, or to ensure that investment will be protected through land tenure (3). This is especially difficult in creating these networks in informal settlements. These issues will need to be addressed on a case by case basis and include settlement of issues like private versus public provision of services.

Two frameworks are critical to how water, sanitation, and hygiene problems will be solved. Policy makers need to decide if they should treat water as a right or as an economic good. In addition, they need to determine if water and sanitation will be provided publicly or privately. As of right now, in some poor places, local entrepreneurs and NGOs are the only sources for water, so a public-private partnership is critical in these places to ensure that, if they decide to not deliver these services themselves, that there are proper regulations for the safe and equitable distribution of water and sanitation (14). Water as a right or economic good, and public versus private provision are interrelated issues, and the decision on one will inform the other. If water is treated as a right, then at least some of water provision needs to be public (or managed and ensured

by the government through private organizations). Governments will need to set lower limits on how much (safe) water per person per day is acceptable, and work to ensure that that amount is provided.

If water is treated as an economic good, then private provision of water and sanitation is more likely. Privatization of water may be beneficial when it comes to care of the water sources – people may take better care of the resource since it is their own property. They may have an incentive to pollute less and use it more efficiently. However, at the country level, if water is treated as an economic good, countries could be more selfish about environmental issues and pollute "their" water when economically advantageous. This can create conflict with other countries when these other countries are downstream or share the same aquifer and receive the pollution from another country. So, public control over some aspects of water may be necessary to ensure the ability to engage in water policy with foreign governments.

In creating policies, context needs to be taken into context, even within a country. The rural experience can be very different than the urban experience. The urban areas have the economies of scale that attract private investment (3). Currently, the majority of private involvement in water and sewerage provision is in urban areas (3). So, privatization may be dependent upon urban or rural context; one solution does not need to fit all regions.

<u>Limitations or challenges in creating water and sanitation projects</u>. In creating and sustaining water and sanitation projects, multiple challenges exist. Projects may fail for a variety of reasons, for example, uncollected payment, especially if there is a culture of non-payment; breakdown and disrepair of pumps and water pipelines; poorly designed

water and sanitation systems; pirating of illegal connections; and either refusing to pay for or not having the resources to pay for fuel to run water pumps (17). Some projects may not be financially viable – in some South African projects cost recovery is as low as 4 percent (17). One author proposes two fundamental factors that cause projects to fail: "1. The desperate poverty of rural people who do not have sufficient incomes to sustain the tariffs set to make the project financially sustainable; and 2. Inadequate sustained social and institutional development in rural areas which impede good public administration of water and sanitation projects" (17).

Health-specific policies

In addition to broader water use policies, health-specific policies are needed to reduce the burden from disease related to unsafe water, sanitation, and hygiene. Prevention, treatment, and education are necessary to decrease this burden. A few policy options related to this are outlined below.

<u>Prevention</u>. Prevention is important in reducing disease from water, sanitation, and hygiene related causes. Prevention polices include those water policies outlined above, since access to safe water can prevent much disease (and supports adequate sanitation and hygiene). On author recognizes that although ORT has been effective in treating diarrhea and reducing deaths, one must also look long-term and reduce the actual incidence of diarrhea itself through sanitation, safe food and water, and related interventions (6). His idea of prevention includes two policies used in tandem – vaccination against those diseases for which vaccines are available and improvement of water and sanitation (6). Immunization programs may help to reduce susceptibility to diarrheal diseases (2). A variety of technologies are available for use in interventions.

Programs should choose the most appropriate and cost-effective technology for a given context. Examples of (relatively) cheap technologies to supply safe water and sanitation include hand pumps, rainwater harvesting, protection of spring water, home-based water treatment such as solar disinfection or safe water systems (which consists of three elements – treatment of water with diluted bleach, safe storage of water, and communication about behavior change), VIP latrines, and pour-flush latrines (24). Interventions do not have to be costly and extensive to have an impact: "In developing countries where resources may be grossly inadequate, particularly in rural or transient communities, much can be still achieved by basic hygiene and sanitation programs" (2).

Water quality is important not just at the point of access but also at the point of use. Ensuring quality storage is important. Water can be stored to use for toilets, washing dishes or hands, bathing, cooking-related activities, and drinking. Cross-contamination through handling this stored water was the main way stored water was polluted in one study (25). One policy to reduce this contamination of stored water is to store water in multiple containers designated by use of the water.

Treatment. Mortality from diseases such as cholera can be extensive. ORT has been "extremely successful" in reducing mortality (2), and as such, it should be continued as a policy to treat acute diarrheal diseases that can come from unsafe water, sanitation, and hygiene. In addition, micronutrients are a potential area to expand new treatment options. Zinc supplementation may reduce duration and severity of acute diarrhea, and vitamin A may also be beneficial (7). Using these micronutrients along with ORT may provide the nutritional support that many children with diarrhea need (7). This may have

the benefit of reducing the morbidity from illness in the first two years of life that was discussed earlier.

Education. Education about safe water, sanitation, and hygiene is critical. Even if safe water and sanitation are accessible, education is necessary to prevent contamination of water at point of use and to ensure that sanitation facilities are used. One way to provide this education may be to include it in primary care efforts. However, the results from this may be limited if the community does not have adequate access to health care facilities. To combat this, training and capacity-building for village health workers is another policy option. Use of village health care workers has been successful in other programs, such as the tuberculosis and HIV efforts by Partners in Health in Haiti. A report from some involved with Partners in Health noted that “village health workers also serve as a vital link between village and clinic, and help attend to the pressing social problems that the majority of our patients face” (26). Training and building capacity at the local level can also help ensure that policies and interventions are sustainable. Hygiene education should ideally accompany water and sanitation interventions, and can include information about ensuring water quality when drawing, transporting, or storing water, where contamination can occur through unclean buckets, unclean hands in water buckets, or uncovered storage containers (24). Hygiene efforts can encourage hand washing after using the toilet, before cooking, or before eating (24). Education should also include valuation of water to ensure efficient use (2). One estimate of the effect of hygiene intervention is that education for hygiene and hand washing can reduce diarrhea incidence up to 45 percent (9).

Education will be particularly important for women. They are often responsible for water collection and food preparation, so these members of the community should be targeted in education efforts. In places with low levels of literacy, education interventions may need to use creative materials to ensure learning as noted earlier.

Conclusions

The above research results, policy ideas, and discussion lend themselves to a variety of policy options. To decrease the disease burden associated with unsafe water, sanitation, and hygiene, countries must determine a policy framework in which to create interventions and infrastructure – is water a right or an economic good? And will water and sanitation be publicly or privately provided? These answers cannot be determined on a global level; context is very important. In addition, some blend may be appropriate. For example, water could be treated as a right with minimum water for health ensured by the government. Public-private partnerships may be created to utilize the strengths of both – for example, having one public system may be easier to plan and manage and private organizations could be contracted with to build and run the system to increase efficiency through the market and allow access to investment capabilities.

Beyond determination of a policy framework, there are a variety of interventions that regions, countries, and even local areas can implement. Education, especially about basic hygiene, is important. Improving efficiency in water use, managing water demand, and ensuring quality through environmental actions will both aid in availability of water for health improvement and decrease the chances of water conflict over this precious resource. Organizations like Water Users' Associations can also help mitigate conflict. Overall, there are still many people who lack access to safe water and sanitation, and the

disease burden related to water, sanitation, and hygiene is large. The policy options presented here can be used to tailor interventions to ensure that they are contextually appropriate.

REFERENCES

1. World Health Organization. WHO Statistical Information System (WHOSIS): Access to improved drinking-water sources and to improved sanitation (percentage). http://www.who.int/whosis/indicators/compendium/2008/2wst/en/.

2. Ford, T. (1999). Microbiological Safety of Drinking Water: United States and Global Perspectives. *Environmental Health Perspectives, 107*(Supplement 1), 191-206.

3. Bakker, K. (2003). Archipelagos and Networks: Urbanization and Water Privatization in the South. *The Geographical Journal, 169*(4), 328-341.

4. Dooley, E. (2004). Safe Water for All. *Environmental Health Perspectives, 112*(1), A47.

5. Pruss, A., Kay, D., Fewtrell, L., & Bartram, J. (2002). Estimating the Burden of Disease from Water, Sanitation, and Hygiene at a Global Level. *Environmental Health Perspectives, 110*(5), 537-542.

6. Smith, K., Corvalan, C., & Kjellstrom, T. (1999). How Much Global Ill Health Is Attributable to Environmental Factors? *Epidemiology, 10*(5), 573-584.

7. Guerrant, R., Carneiro-Filho, B., & Dillingham, R. (2003). Cholera, Diarrhea, and Oral Rehydration Therapy: Triumph and Indictment. *Clinical Infectious Diseases, 37*(3), 398-405.

8. Keirns, P. (2007). *Water Supply and Sanitation Services for the Rural Poor: The Gram Vikas Experience*. Warwickshire, UK: Practical Action Publishing.

9. World Health Organization. Water, Sanitation, and Hygiene Links to Health: Facts and Figures. http://www.who.int/water_sanitation_health/factsfigures2005.pdf.

10. Gelletly, L. (2007). *AIDS and Health Issues.* Philadelphia, PA: Mason Crest Publishers.

11. Aeschbacher, J., Liniger, H., & Weingartner, R. (2005). River Water Shortage in a Highland-Lowland System: A Case Study of the Impacts of Water Abstraction in the Mount Kenya Region. *Mountain Research and Development, 25*(2), 155-162.

12. Wu, C., Maurer, C., Wang, Y., Xue, S., Davis, D. (1999). Water Pollution and Human Health in China. *Environmental Health Perspectives, 107*(4), 251-256.

13. Jackson, R., Carpenter, S., Dahm, C., McKnight, D., Naiman, R., Postel, S., & Running, S. (2001). Water in a Changing World. *Ecological Applications, 11*(4), 1027-1045.

14. Lundqvist, J., Appasamy, P. & Nelliyat, P. (2003). Dimensions and Approaches for Third World City Water Security. *Philosophical Transactions: Biological Sciences, 358*(1440), 1985-1996.

15. Ebong, R. (2002). Appraisal of Knowledge and Attitude of Akwa Ibomites toward a Sustainable Environment in Nigeria. *Environmental Health Perspectives, 110*(3), 211-212.

16. Swatuk, L. (2002). The New Water Architecture in Southern Africa: Reflections on Current Trends in the Light of 'Rio + 10'. *International Affairs (Royal Institute of International Affairs 1944-), 78*(3), 507-530.

17. Hemson, D. (2000). Accelerated Delivery? Rural Women and Water. *Agenda, 45*, 54-65.

18. Levin, R., Epstein, P., Ford, T., Harrington, W. Olson, E., & Reichard, E. (2002). U.S. Drinking Water Challenges in the Twenty-First Century. *Environmental Health Perspectives, 110*(Supplement 1:Reviews in Environmental Health), 43-52.

19. Oxfam International. (2006). *The Public Interest: Health, Education, Water and Sanitation for All.* Oxford, UK: Oxfam Publishing.

20. Behrman, J.R., Behrman, J.A., & Perez, N.M. (2009). On What Diseases and Health Conditions Should New Economic Research on Health and Development Focus? *Health Economics, 18*, S109-S128.

21. McGillivray, M. (2008). The Millennium Development Goals: Overview, Progress, and Prospects. In M. McGillivray (Ed.), *Achieving the Millennium Development Goals* (pp. 1-19). Hampshire, UK: Palgrave Macmillan.

22. Anand, P.B. (2008). The Achieving the Water and Sanitation Millennium Development Goal. In M. McGillivray (Ed.), *Achieving the Millennium Development Goals* (pp. 90-122). Hampshire, UK: Palgrave Macmillan.

23. Griffin, R. & Mjelde, J. (2000). Valuing Water Supply Reliability. *American Journal of Agricultural Economics, 82*(2), 414-426.

24. Wegelin-Schuringa, M. & Kamminga, E. (2006). Water and Sanitation in the Context of HIV/AIDS: The Right of Access in Resource-Poor Countries. *Health and Human Rights, 9*(1), 152-172.

25. Pinfold, J. (1990). Faecal Contamination of Water and Fingertip-Rinses as a Method for Evaluating the Effect of Low-Cost Water Supply and Sanitation Activities on Faeco-Oral Disease Transmission. I. A. Case Study in Rural North-East Thailand. *Epidemiology and Infection, 105*(2), 363-375.

26. Walton, D., Farmer, P., Lambert, W., Leandre, F., Koenig, S., & Mukherjee, J. (2004). Integrated HIV Prevention and Care Strengthens Primary Health Care: Lessons from Rural Haiti. *Journal of Public Health Policy, 25*(2), 137-158.