Acting on an Environmental Health Disaster: The Case of the Aral Sea

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The Aral Sea area in Central Asia has been encountering one of the world's greatest environmental disasters for more than 15 years. During that time, despite many assessments and millions of dollars spent by large, multinational organizations, little has changed. The 5 million people living in this neglected and virtually unknown part of the world are suffering not only from an environmental catastrophe that has no easy solutions but also from a litany of health problems. The region is often dismissed as a chronic problem where nothing positive can be achieved. Within this complicated context, Medecins Sans Frontieres, winner of the Nobel Peace Prize in 1999, is actively trying to assess the impact of the environmental disaster on human health to help the people who live in the Aral Sea area cope with their environment. Medecins Sans Frontieres has combined a direct medical program to improve the health of the population while conducting operational research to gain a better understanding of the relationship between the environmental disaster and human health outcomes. In this paper we explore the health situation of the region and the broader policy context in which it is situated, and present some ideas that could potentially be applied to many other places in the world that are caught up in environmental and human health disasters. *Key words:* Aral Sea, Central Asia, Kazakhstan, Medecins Sans Frontieres, Uzbekistan. *Environ Health Perspect* 109:547–549 (2001). [Online 18 May 2001]
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There is a common saying in the Aral Sea area: "if every specialist brought with them a bucket of water, the Sea would be filled again." Countless scientific expeditions and assessments have been conducted in the area, to the degree that the population is "assessment fatigued," still distressed, and yet little further ahead. At this point there is a wealth of information on the causal nature of the disaster, but despairingly little on its effects on human health (*1*). The media produce sound bites about the region focusing largely on the environmental catastrophe, with little coverage on how the health of the population is affected. The catch phrase is the "death of the Aral Sea," and the fact that 5 million people are living within a degraded and increasingly uninhabitable environment is not mentioned.

The Aral Sea consists of the territory of two Central Asian states formerly of the Soviet empire: Uzbekistan and Kazakhstan. The sole water source that counters evaporation of this terminal sea are two rivers, both of which are extensively tapped for irrigation purposes to produce cotton and rice, and both crops require immense quantities of water. Unlined and uncovered, the irrigation systems are extremely inefficient and poorly maintained. Consequently, less and less water reaches the sea (*2*). Sitting in a vast desert, the sea evaporates. The entire ecosystem verges on collapse. The intensive agriculture and abundant irrigation has resulted in the salinization of the land and the contamination of the water supplies by salt and agricultural chemicals. The fish basket of Central Asia has become the waste basket of the region, as a large proportion of the salts and agricultural chemicals upstream are deposited in the area. As desiccation of the sea bed continues, these salts and chemicals amass on the dry sea bed and are blown back into the face of the population. The increasingly frequent dust storms now displace roughly 43 million tons of dust per year (*3*). If and when the Aral Sea completely dries up, countless tons of salts will be exposed and sent airborne. Clearly, given the chain of causal events, the Aral Sea crisis is not just about water: air quality, nutrition, climate, the economy, and the health care system are also plunged into crisis. Towns such as Muynak, which previously were on the shores of the Aral, but are now farther than 100 km away from the receding sea, are some of the most chronically sick places on earth.

Here we explore the health situation of the region and present ideas on how an operational approach can be taken in complex environmental health disasters. We think that this approach could potentially be adapted to similar environmentally fragile and devastated areas in the world. We summarize the health, social, and environmental impacts of the disaster and discuss some of the broader scientific and policy issues relevant to taking action to improve health in the Aral Sea area.

Health Effects

For ease of analysis, two sets of health implications can be described, although they are not mutually exclusive. The first is those diseases and health conditions that are not necessarily directly linked to the environmental disaster. Such diseases are the leading causes of morbidity and mortality in the region and are essentially common public health problems, symptomatic of a population suffering from disruption and upheaval. The most serious concern is the continued spread of infectious diseases such as tuberculosis, hepatitis, and respiratory and diarrheal diseases (*4*,*5*). The incidence and prevalence of these diseases in the Aral Sea area are among the highest in all of the former Soviet Union and are higher than national averages (*6*).

The other sets of diseases are the complex chronic health problems for which neither the causes nor measures to prevent them are clear. The potential of the environmental disaster directly impacting human health lies within such concerns as the salinization of the water table, pesticides in the environment and food chain, and dust storms and air quality (*7*). The associated diseases and health conditions could be elevated rates of hypertension, respiratory conditions, heart disease, anemia, various cancers, and kidney disease. Other suspected adverse health consequences relate to the maternal–fetal interface such as potential teratogenesis, endocrine disruption, and neurodevelopmental and behavioral effects associated with high exposure to persistent organic pollutants (*8*). These diseases have a greater probability of having direct biomedical links to the environmental destruction than infectious diseases, but sound research is needed for a clearer understanding of their etiology so that effective preventive action can be taken.

Health Infrastructure

Apart from the epidemiologic concerns of the region, the state of the existing health infrastructure and medical system must also be considered. The hospitals and health centers in the Aral Sea area lack essential medicines and medical equipment. The health professionals are present and eager to work but do not have the means to perform their jobs effectively. They require access to new international protocols and tools for treating disease and improving health services, including effective health information systems, public health

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infrastructure, the development of a primary health care approach, and access to essential medications and diagnostic equipment.

Water Quality

To have a drink of water in the Aral Sea area could be detrimental to your health.

The Aral Sea area is confronted with a crippling water crisis. The lack of availability of water is precisely the reason for the death of the Aral Sea and for the associated litany of negative ecologic and human health effects. The desiccation of a vast body of water has changed the regional climate (*2*). The salt content of the sea has gone from slightly brackish to 70 g/L, and may reach as high as 140 g/L, a higher salt content than the oceans (*2*,*9*). The 20 fish species in the sea, which were an important economic and nutritional element in the region, have died (*9*).

Not surprisingly, the quality of water for human consumption is poor. Those processes that contributed to the sea's desiccation—over-irrigation and water mismanagement—have also resulted in a rise of the groundwater table, which then became contaminated with high levels of salts and other minerals. Groundwater quality ranges from a minimum of 0.5g/L total dissolved salts (TDS) to an astounding 6 g/L, 20 times more than in North America (roughly 300 mg/L TDS). Drinking water reaches levels of up to 3.5 g of TDS/L (*10*).

The Uzbekistan government has set the salt limit at 1 g/L TDS; in line with the World Health Organization's international standard. TDS standards are frequently set as related to palatability (*11*). When the World Bank conducted a consumer preference survey, it set the rate at 2 g/L TDS (*12*,*13*); a recent United Nations Development Program pilot hand-pump project intended to bring ground water to rural consumers, allowed a level as high as 3 g/L TDS (*14*). In other words, acceptable levels of mineralization are set by personal preference or operational difficulties. Agriculturists can pinpoint a precise ratio and relationship between mineralized or salinized water and crop production, but there is no universally accepted level of water mineralization for human consumption, and reliable data on possible health effects associated with the ingestion of TDS in drinking water are not available (*15*).

Palatability is, of course, an important consideration when discussing water quality. People will not drink enough water if they do not like the taste. In refugee camps, water is chlorinated to avoid cholera. If so much chlorine is used that it becomes unpalatable, people will go outside the camp fence and drink from the closest natural source. In the Aral Sea area, there is no choice. Is palatability the appropriate standard setting for water quality alone?

In terms of chemical contamination, the situation is grim. In Karakalpakstan, an autonomous republic within Uzbekistan that borders the former Aral Sea, about 65% of drinking water samples tested do not correspond to standards (*16*).

Psychosocial and Adaptability Issues

Until recently, little was known about the psychologic effects on a population that has witnessed the complete destruction of their environment and had their livelihoods destroyed in less then a generation—a population that has little hope for restoring their home. A recent study (*17*) showed that almost one-half of the population reports levels of somatic symptoms associated with emotional stress. This finding is comparable to acute environmental disaster studies in North America but higher than findings from chronic, nonacute environmental exposures.

Moreover, in the same study, 48.8% of the respondents indicated that they wanted to leave their homes because of the environment, and one-half of those wanted to move out of the Aral Sea area. Recently, the issue of migration in the Aral Sea area has resurfaced as evidenced by anecdotal reports of people leaving the area because of the severe drought in 2000. The drought has resulted in reduced crop yield and consequently threatens food security in the area and worsens water quality. The prospects for the resolution of the drought remain doubtful because precipitation levels are normally low, and riparian disputes preclude the release of more water from upstream. A prolonged drought could make the area uninhabitable, particularly close to the former shores of the Aral Sea. What is the potential for adaptation?

Environmental Refugees

The "environmental refugee or migrant" has become an identifiable subgroup of those fleeing from their homes, added to the long list of war and political refugees and economic migrants. At a Commonwealth of Independent States conference on refugees and migrants, held in Geneva in 1996, the estimated number of displaced people due to the environmental disaster in the Aral Sea region alone was more than 100,000 people (*18*).

Typically, refugees are potentially destabilizing either because they create new demands in the host community or because they rebel against the forces that led them to flee in the first place. The situation and the effects of environmental refugees in the Aral Sea area are different, particularly when considering that those that have left did so because they had the opportunity, skill, and fortitude to leave and adjust to a new way of life. The concern is that the population left behind has even fewer capacities, skills, and potential to remedy or at least adapt to the problem. This is particularly the case when it comes to the availability of trained medical staff and health administrators. Thus, the downward spiral of the environmental disaster continues to descend, leading to further negative social implications. The drought may aggravate the situation further. Medecins Sans Frontieres is responding to the need to understand these trends by sponsoring a demographic study on migration and collaborating on the assessment of the severity of the drought.

Separating Cause and Effect

Medecins Sans Frontieres is the only international humanitarian, medical, nongovernmental organization based in the Aral Sea area. One of the reasons the area is neglected by the international community is due to a paradigm that has difficulty separating cause and effect. As stated earlier, there are questions about how the environmental water disaster is impacting human health. Due to the lack of answers, health policies are often set ad hoc, if they are set at all. In turn, the development of appropriate and effective interventions is slow or nonexistent. It is through operational research that is grounded in the needs of the population and aims to directly improve the health of the population that advances can be made.

Operational research can be regarded as a type of rapid public health assessment. In the Aral Sea area, Medecins Sans Frontieres has concentrated on assessing the health priorities of the population, fostering partnerships between universities in the western world and Uzbek and Karakalpak scientists, and characterizing exposure–outcome pathways. So far, studies on key informant's perspectives, psychosocial impacts of the environmental disaster, childhood respiratory health, renal health, food chain contamination, dust composition, and water quality have been completed or are ongoing. A critical gap to fill is how to communicate environmental risk in Central Asia. The considerable research on these topics derives chiefly from Western democratic nations, where environmental health issues are part of open and informed debate. It is unlikely that the results of such literature can be directly applied in Karakalpakstan, still in the shadow of 70 years of authoritarian Soviet rule. Such information is required for the creation of risk reduction strategies that can be used by the population.

The unifying theme of operational research is what has been termed the "missing pier" by Wilfred Karmaus (Department of Epidemiology, Michigan State University, East Lansing, MI). Operational research is a type of community-based public health research. The research focus is on multiple

exposures and outcomes with the aim of developing insight and understanding of the local environment as opposed to the academic scientific model of hypothesis testing research with a focus on single exposure–outcome pathways. The results of such a process feed directly into strategies for problem solving.

Following the results of these operational research projects, advocacy will play an important role. The goal is to advocate for the recognition of the links or their absence between the environmental disaster and human health outcomes and to ensure that policy and health and environmental interventions are developed on the basis of the results of this operational assessment.

Fully understanding cause-and-effect relationships is not necessary for improving health. This is recognized by most public health practitioners. Often the call for specific causation is used as a smokescreen to hamper remediation efforts that are contrary to either governmental or industrial interests. The weight-of-evidence approach, which has its origin in the work of Bradford Hill (*19*), has been advocated as a companion to the precautionary principle in environmental health assessment (*20*,*21*).

The particular demands of environmental health assessment in the developing world raise important issues for etiologic research. There are facts in the Aral Sea area that demand action. Perhaps there is a remote biomedical connection between the environmental disaster and the tuberculosis epidemic in the region. One of the best ways to improve the health status of the region is to facilitate improvements in the health care system infrastructure by assisting in the implementation of the World Health Organization's Directly Observed Treatment, Short-Course. Nevertheless, there are questions about environmental impacts on health that require the attention of scientists worldwide.

Development versus Immediate Humanitarian Needs

The numerous assessments in the region have concentrated primarily on large-scale and long-term industrial projects, ranging from the classic, and now hopefully permanently archived, scheme of bleeding the rivers of Siberia to feed the Aral Sea, to the almost as expensive and ambitious large-scale infrastructure programs designed to bring piped water to the communities throughout the region. Although sustainable development plans and ecologic recovery need to be part of the long-term objective in the region, they will take years to begin to take hold, let alone bear fruit. Immediate basic human needs must be addressed. In the Aral Sea area, it must be realized that the level of health and the quality of life is profoundly poor and deteriorating further.

There is a tendency in informal parlance to describe the disaster in the past tense, yet the same process that has desiccated the sea continues taking its toll on the health of the region. While many places in the world have shown a positive increase in the quality of life, in the Aral Sea area it continues to fall.

Twenty-five years ago, did the world realize that the great rivers of Central Asia would, within a generation, no longer reach the Aral Sea? How long will it be until the river does not even reach and supply water to the population in the region? How many years will the region be able to sustain human life, let alone get on a path toward development? Without humanitarian assistance today, ideas of sustainable development will not see tomorrow.

Conclusions

Due to the development of a situation of environmental scarcity, several negative social effects ensue. In the case of the Aral Sea area, these social effects include health effects, migration, and economic decline. Migration and economic decline further contribute to the spiraling downward of the environmental disaster as the population is no longer able to adapt and cope (*22*). In addition and, to a degree, as a result, adverse health effects continue to increase.

Based on empirical efforts in the Aral Sea area, and realizing that the Aral Sea area is only one example of many tragedies, we have suggested an approach to act on environmental and health disasters through operational research and humanitarian aid.

Environmental health is a relatively new discipline, and as such is still largely Western based and research focused. Yet, given our changed and changing environment and the increasing water crisis throughout the world, which will have negative effects far beyond the conventional concerns of safe drinking water, research, or rather operational research, will increasingly have a role to play. At the same time, communities such as those in the Aral Sea area are becoming increasingly assessment fatigued and frustrated with the lack of direct assistance. Populations suffering from an environmental disaster require direct interventions to improve their health, and research into more complicated cause-and-effect relationships are slow to produce results. Research cannot stand alone. It needs to be combined with a direct health improvement for the population, even if the ills are not conventionally seen as water based. Advocacy is key to turning research into policy and into action, while at the same time ensuring that populations receive humanitarian assistance as they wait for research policy and sustainable long-term solutions to catch up.

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