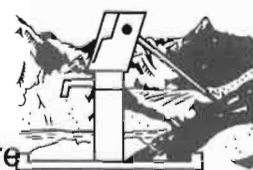


## WATER, ENVIRONMENT AND MANAGEMENT

## Health effects of small dams in Mali

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## BACKGROUND

Small scale irrigation projects may be accompanied by negative health impacts for several reasons. First, the extension of a year-round supply of water in dam reservoirs improves and expands habitats for disease-spreading hosts and vectors of parasitic diseases. Second, factors such as proximity, lack of safe and convenient drinking water supplies, inadequate sanitation, and poor hygiene practices result in increased human exposure to disease because people use contaminated waters (intended for irrigation) for nonagricultural purposes.

This paper presents results of a rapid qualitative assessment of the health consequences of small concrete dams (height less than 3 meters, length 100 to 150 meters) in the Dogon Region of Mali, West Africa. The purpose of the study was to 1) document adverse health conditions related to the dams, 2) recommend remedial interventions, 3) develop environmental health assessment guidelines for proposed small dam irrigation development projects, and 4) assess other health risks related to water supply and sanitation.



Figure 1: Small concrete dam located in Dourou. Onion gardens are built adjacent to the dam. Note the aquatic vegetation in the reservoir.

The Dogon is in the Bandiagara plateau in central Mali and is a semi-arid region receiving only 467.0 millimeters of rainfall annually. The region has two seasons: a dry season from October to May, and a rainy season from June to September. The terrain is rugged, rocky, hilly country with scattered tree cover, deep gorges, valleys, and large eroded sandstone outcrops. The few flat rocky spaces are covered with very thin soils with little water retention capacity. These poor soils make up the largest part of the plateau's arable land. The purpose

of small dam construction, which began in the 1940s, was to increase the water supply for onion gardening, the principal dry season income-producing activity in the region. To date, 108 small dams have been constructed by a variety of international donors.

In order to investigate health impacts, this study used a classification of water-associated diseases that breaks health problems into four categories: waterborne, water-washed, water contact, and water-related, after McJunkin (1982). Representative and locally significant diseases within each category studied were:

- Waterborne: Diarrheal Disease and Dracunculiasis (Guinea Worm Disease)
- Water-Washed: Skin and Eye Infections
- Water Contact: Schistosomiasis
- Water-Related: Malaria and Onchocerciasis

## MATERIALS AND METHODS

The study was conducted by a six-person interdisciplinary team that included three Malians. Four weeks were spent in Mali during September 1991. The team subdisciplines were public health, tropical disease, anthropology, environmental engineering, water resources management, and construction engineering. No village or regional health data were available. Therefore, for comparative purposes, the team studied villages with dams and without dams. Focus group discussions were conducted using a questionnaire developed by the team. The questionnaire covered knowledge, attitudes, and practices in 1) drinking water supply, use, storage, and collection; 2) hygiene; and 3) health. Field observations were made of 1) structures including the dams, reservoirs, and sanitation facilities; 2) water contact activities; 3) water sources; and 4) water collection, storage, and filtering practices. The team visited 13 villages with populations ranging from 100 to 1,000 during a 12-day field period. Additional information was gathered through interviews with government agencies, international donors, and nongovernmental organizations.

## RESULTS AND DISCUSSION

Villagers considered diarrheal diseases the most lethal of all illnesses. Diarrheal diseases are most common during the rainy season and affect people of all ages. These diseases

are particularly common among children under 5 and are a typical cause of death in infants. In a sample of 155 children, diarrheal disease for the period two weeks prior to the study ranged from 8 to 35 percent in the villages. One village estimated that diarrhea kills one of every two children. Dogon mothers frequently supplement breast milk for nursing infants with drinking water. Many villagers were unsure of the cause of diarrheal disease, although some association with poor drinking water or bad food was mentioned. Home remedies are used for treatment. Surprisingly, only one village was aware of the most commonly accepted and promoted form of treatment, Oral Rehydration Treatment (ORT).

**Guinea worm** is common throughout the Dogon. Due to a national guinea worm eradication effort that includes the participation of a number of Peace Corps volunteers, most villagers knew of the connection between guinea worm and the drinking water supply. In villages with no improved drinking water supply, health education programs had attempted to teach safe water filtering techniques. However, observation revealed that these were not practiced correctly, leading villagers to mistakenly believe they were drinking safe water. Villages with an improved drinking water supply, i.e., a handpump or borehole-cistern well, noted the eradication of guinea worm that accompanied the provision (and use) of the improved water supply source.

**Yaws**, which is prevented by good personal hygiene, is endemic in the Dogon. Compared with villages with dams, in villages without dams children appeared dirtier, and had more **eye and skin problems**. Yet skin infections were common in all villages, particularly among children. Cases of trachoma and conjunctivitis were a common complaint. Villages without dams had dirtier children with runny eyes and other skin problems. When children swim and bathe in impoundments, and people wash clothes with more frequency because of the proximity of the dam, water-washed diseases seem to be reduced.

Virtually all **schistosomiasis** in the Dogon is *Schistosoma haematobium*, which is characterized by blood in the urine—an easily recognizable symptom to villagers. Transmission occurs when an individual comes into contact with infected surface waters. Schistosomiasis was present in all communities visited. Because schistosomiasis is so widespread, has existed as far back as the elders can remember, and exhibits a symptom (blood in the urine) that eventually disappears, many Dogon do not consider schistosomiasis to be a disease and rarely seek treatment for it. Blood in the urine is thought to be sent by God or is considered a necessary rite of passage for children. If dams result in increased habitat for the host vector, snails, and observed water contact activities increase as a result of the presence of an impoundment, then dams could be the cause of an increase in schistosomiasis. Therefore, the team looked for habitats suitable for snails, the host for the disease-causing vector of schistosomiasis, and observed water contact behavior.

Aquatic vegetation, which serves as a habitat for snails, was found in most reservoirs. Where it was not present, the reason was inappropriate environmental conditions, not harvesting. Since control measures for schistosomiasis include removal of the aquatic vegetation, the team was interested in perceived benefits of the vegetation. Some villagers thought it reduced evaporation; others mentioned that it was good for fish. Also, it is used for animal feed, and some people eat the fruit of the lily pad. Since no negative effects are associated with the vegetation, education appears necessary to convince villagers of the importance of removing aquatic vegetation from the impoundments.

Numerous water contact behaviors that place villagers at increased risk of schistosomiasis transmission were reported and/or observed by the team. Irrigation techniques place workers at high risk. Workers wade knee deep into the reservoir and fill a vessel (calabash) by submerging their hands and arms in the water (see figure 2). This procedure is



**Figure 2: Irrigation practices require farmers to wade into waters that are often contaminated with schistosomiasis.**

repeated many times daily. Crops are hand watered with water from the calabash. Measures have been proposed in the Dogon to protect workers, such as the use of handpumps to deliver the water to the fields. These have been unsuccessful, however. Recreational and domestic water contact behaviors were also reported and observed by the team, including swimming, bathing, and clothes washing in the impoundment.

**Malaria**, a disease transmitted by mosquitoes, is endemic in the region. While impoundment and water use create additional potential breeding sites for disease-transmitting mosquitoes, malaria is endemic both in villages with and without dams. There is no active control program. Many Dogon complained of fever, the main symptom associated with malaria. Very few villagers related the disease to mosquito bites, another indication of the inadequate health education in the region. In a sample of 107 children, 41 had malaria-related fevers at some point during the previous rainy season. Traditional remedies are most commonly used.

**Onchocerciasis** is transmitted by black flies that breed in rivers and streams. Dam spillways are particularly suitable breeding sites, hence the relationship with dams. Mali was included in the original zone covered by the WHO Onchocerciasis Control Program. After 15 years this program has proven very effective and a generation has grown up without this disease and its associated blindness. Villagers did not note onchocerciasis as a health concern and the team observed very few cases of blindness in any villages studied.

Since a village's **drinking water supplies, sanitation practices, and hygiene behavior** all affect the diseases examined in this study, these areas were also examined. The sources of drinking water were found to vary throughout the year and are related to seasonal rain patterns. In the four-month rainy season, running streams are commonly used. As the dry season begins, these waters are depleted, as are shallow wells and puddles—additional drinking and domestic water supply sources. Later in the season, with wells and puddles dry, shallow holes are dug in the dry riverbed and water for drinking is collected in this manner. Many villages in the Dogon, even those without dams, have a protected water supply source provided by various donor organizations. Only one village in this study had no protected water supply, nor did it have a dam.

Safe drinking water supplies include improved wells and boreholes equipped with handpumps as well as borehole-cistern wells. All villages with dams had an improved drinking water supply source that had been provided usually sometime after the dam had been built. For several years, the provision of a safe drinking water supply for the village has been required of small dam development projects, and villagers have been instructed not to drink water in the dam. Therefore, an important question to be answered in the study was whether villagers drink the water impounded by the dam. All villagers clearly knew to say they did not. However, further probing and discussion of the importance of honest answers revealed that in all but one of the villages studied that have dams, the villagers drank the impounded water at least occasionally. The village that did not was the only village studied that had a school and a strong health education program. This is an example of the impact of education on health conditions. Despite warnings and the presence of alternatives, usually safe drinking water sources, the villagers choose to drink the impounded water because of convenience and taste. When the pump is a 20- to 25-minute walk from the village compound and the dam is 5 minutes, villagers drink from the dam.

Another issue of convenience involves the scarcity of rubber well bags used to draw water from the well. This scarcity requires some families to wait their turn at the well. Compounding the convenience issue is the question of taste. "Sweet-tasting" ponds are often preferred drinking water sources over water from handpumps, which often has an iron taste due to corrosion of the pipes. No economical solution has yet been found to this technical problem, and in the

absence of a strong health education program, villagers can be expected to continue using contaminated drinking water supplies periodically.

A safe drinking water supply is not sufficient to realize health benefits. Proper use and maintenance of the protected water supply are essential. Several observations suggest that unsafe practices are in use in many Dogon villages. For example, no well covers are used. Wells installed with covers have had them removed by the villagers, who find lifting heavy covers a nuisance. Furthermore, since there is no safe method of retrieving water from the wells, the possibility for contamination of the water supply is high.

Most Dogon compounds contain thatched or walled enclosures used for urination and bathing. Most villages have no latrines, so residents defecate "in the bush" or in the area surrounding the village. The team found human excrement in close proximity to the dams in several villages. Many of the designated defecation sites were located so that runoff would go into the impoundment. These sanitation practices result in conditions in all villages that foster the spread of many water-associated diseases. Pit latrines were found to be rare and were associated with public services such as schools and rest houses. The few cases of privately owned latrines belong to village chiefs, merchants, midwives, government functionaries, or families with members who had migrated to urban areas. Most villagers were very interested in building latrines, with the main advantages being privacy, convenience, easy access, and social status. The main obstacles were cost, lack of knowledge about construction, and a national latrine construction program hampered by lack of funds, transport, and staff.

Villagers perceive clear economic benefits from dams. In addition, they claim health has improved since the dams were constructed. It is not clear if this perception is due to the general association of dams with well-being, an actual improvement in nutrition, or better health related to water-washed diseases.

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## CONCLUSIONS AND RECOMMENDATIONS

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The study concluded that dams are a source of increased prevalence and intensity of schistosomiasis, but because they are not a primary source of drinking water, they do not present other significant health risks. On the positive side, dams may result in slightly reduced water-washed diseases. Clear linkages between other health problems and the presence of dams were difficult to demonstrate given the complexity of disease transmission and of human behavior. A relationship between unsafe drinking water and disease was evident in the case of guinea worm disease. Health conditions were found to be universally poor due to lack of basic health care, lack of education, poverty, and unsanitary living conditions. It was concluded that there are pressing health issues in the Dogon that should be addressed, particularly diarrheal disease control.

The team attempted to make simple, implementable recommendations to the Government of Mali, nongovernmental organizations, USAID, the Peace Corps, other bilateral donors, and multilateral donors. They are briefly:

- Continue the national schistosomiasis treatment program and expand to all villages in the Dogon.
- Improve health education and direct it toward women.
- ensure provision of a safe drinking water supply in all small dam projects and remove unsafe water sources.
- Involve the community in all aspects of dam projects.
- Coordinate all development activities, possibly through a local NGO.
- Consider alternative irrigation approaches and other measures to minimize water contact.

- Construct dams with mechanisms that allow for regulation of the water level.
- Explore malaria control practices.
- Implement pilot latrine programs.
- Target the Dogon for child survival programs.

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