Perception is Reality

PERCEPTION MOLDS people's reactions to the world around them. In West Africa, the perceptions that communities have of the potentially deadly disease of schistosomiasis make it particularly challenging for prevention programs to be implemented successfully.

Wetland water management and irrigation schemes are thought to make vector-borne disease endemicity worse in West and Central Africa. The development and promotion of wetland, or irrigated, rice cultivation has been restrained because of such health concerns. However, with the rapidly growing consumer demand for rice in the region and the limited options for intensification of upland areas, wetland rice development becomes a major focus for agricultural policy-makers and farmers. Inland valley bottoms in West and Central Africa represent approximately 50% of the agriculturally available wetland area (375,000 to 842,910 km^2).

The Human Health Consortium brings together six multidisciplinary West African research institutions (*see* Box) to evaluate the health and social impacts of various degrees of wetland water management and irrigation in the humid rain-forest, savanna and Sahel zones. This work is conducted with a view to providing relevant information to planners and policy-makers. The Consortium focuses on two major vector-borne diseases—malaria and schistosomiasis. Results are to be used to develop environmental management strategies that will minimize the health risks related to land use. We have previously looked at malaria ('Rice Cultivation: Kill or Cure?' *WARDA Annual Report 1996*, pages 27–31); this year we turn to schistosomiasis.

The Human Health Consortium

National Institutions

Côte d'Ivoire
- *Centre universitaire de formation en entomologie médicale et véterinaire* (CEMV), Bouaké
- *Institut Pierre Richet* (IPR)/OCCGE, Bouaké
- International Development Research Centre (IDRC, Ottawa)

Mali
- *Faculté de médecine, de pharmacie et d'odonto-stomatologie*, Malaria Research Training Centre, DEAP, Bamako
- *Institut d'economie rurale*, Niono/Bamako
- *Institut national de recherche en santé publique*, Bamako

International Institutions
- West Africa Rice Development Association (WARDA/ADRAO)
- World Health Organization Panel of Experts on Environmental Management for Vector Control (WHO-PEEM)

Donors
- Denmark (DANIDA)
- IDRC
- Norway

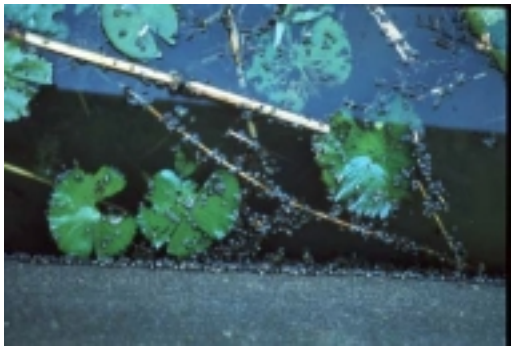
Targeted funds for the Health Consortium were provided from May 1994 to June 2000, during which period the objectives were accomplished. Health-related research continues at WARDA on the nutritional impact of NERICA varieties on farm families, especially children.

The disease

Schistosomiasis, also known as bilharziasis, is the second most common parasitic disease in the world after malaria. It is estimated that some 200 million people in 76 developing countries are infected world-wide. Of these, about two-thirds show symptoms, and about 10% (that is, about 20 million people) will suffer serious, debilitating disease—80% of all cases occur in Africa.

The disease-causing organisms develop alternately in humans and aquatic snails. Snail-infective parasites are excreted in human feces and urine, and human-infective parasites are released in millions from infected snails. Thus, the disease is prevalent where people are in frequent contact with snail-infested water. The snails require vegetated banks of lakes and slow-moving rivers to live in. It is not surprising, therefore, that there has long been concern over the role of agriculture in general, and irrigated rice farming in particular, in increasing the incidence of schistosomiasis.

The alternate hosts of schistosomiasis are tiny aquatic snails (left), which favor still or slow-moving water with plenty of vegetation (below)



Impact of human activity

People depend on water to live; they also alter their environment to meet their needs—rather than adapting to their environment, which is what most other forms of life do. People use water sources for drinking, cooking, washing and recreation, and how they manage their water resources can have a major effect on the incidence and spread of schistosomiasis. For example, we have stated that snail-infective schistosomes are excreted in urine and feces, so if a community allows its members to urinate or defecate near snail-infested water, the disease cycle is going to be continually refueled. Conversely, if these activities are kept away from the water source, the supply of snail-infective organisms should be significantly reduced.

Conditions 'on the ground'

Although schistosomiasis has the potential to be a problem in most rice-growing areas of West and Central Africa, we find that the situation in each ecology is primarily influenced by how people behave in the vicinity of water. The prevalence of schistosomiasis is high in both the Sahel and the forest zone. In the Sahel, the disease is (probably correctly) seen as a direct result of irrigation practices introduced in the 1970s. This has particularly been the case in the *Office du Niger* scheme of Mali, where development agencies were blamed for schistosomiasis 'epidemics' when they developed and rehabilitated the irrigation infrastructure. As a semi-desert habitat, the Sahel has very little standing water, except for irrigation schemes, so these are the very areas where snail populations build up and people congregate to collect essential water supplies.

In the forest zone, there is plenty of slow-moving and standing water. Here schistosomiasis is associated with

sites where commonly-used pathways traverse streams and slow-moving rivers. It is here that human–water contact is at its greatest in this zone. Overall, about 70% of the population is affected, with very high worm-loads in infected individuals, but it is difficult to show any effect of wetland rice farming in increasing disease prevalence. Rice fields themselves have no floating vegetation for the snails to live in, but irrigation infrastructure may provide suitable snail habitat. We found large differences in prevalence rates in school children between villages, both within and across rice-cropping systems—for example, 0–51% for *Schistosoma haematobium*, and 4–77% for *S. mansoni* (*see* Table 2)—but these could not be linked to the size of rice cultivations in village perimeters in inland valleys nor to the cropping system (single or double cropping) used.

In strong contrast to the situation in these habitats is the situation in the savanna. Here, communities are far more conservative in their toilet habits. So, despite the existence of more water than in the Sahel, the only major risk group is the children who swim. Again, we observed large differences in disease prevalence rates between villages in similar habitats, indicating no simple link between rice cultivation system and disease prevalence (*see* Table 2). Irrigation schemes established in the early 1970s seem to have had no effect on the disease burden of the communities using them—in both single- and double-cropped areas, schistosomiasis-infection prevalences are low, with low parasite counts in infected individuals. Conversely, populations with access to dammed lakes tend to be

Recreational use of water makes for high risk of schistosomiasis infection, especially in children

Table 2. Prevalence of schistosomiasis in school children in the forest and savanna zones of Côte d'Ivoire.

Zone	Rice system†	No. villages	*S. haematobium* prevalence (%)		*S. mansoni* prevalence (%)	
			Mean	Range	Mean	Range
Forest	R0	7	1.7	0.4–4.9	17.5	3.7–50
	R1	7	4.4	0–51.2	46.6	16.7–65.1
	R2	7	0.9	0–2.6	61.3	20.3–77.2
Savanna	R0	8	0.7	0–2.2	2.1	0–6.3
	R1	8	2.3	0.5–6.2	11.9	1.5–26.9
	R2	8	4.8	0–30.8	16.1	4.9–38.3

† R0 = villages without rice cultivation; R1 = villages with one rice crop per year, in inland valleys with no or partial water control; R2 = villages in inland valleys with partial or complete water control that permits two or more rice crops per year.
Data from individual villages were subjected to angular transformation, one-way ANOVA and then Scheffé's posthoc test for multiple comparisons. (1) In both zones, there was no significant difference between cropping systems for *S. haematobium*. (2) For both zones, *S. mansoni* prevalence in R0 was significantly ($\alpha = 0.05$) lower than that in R1 and R2.

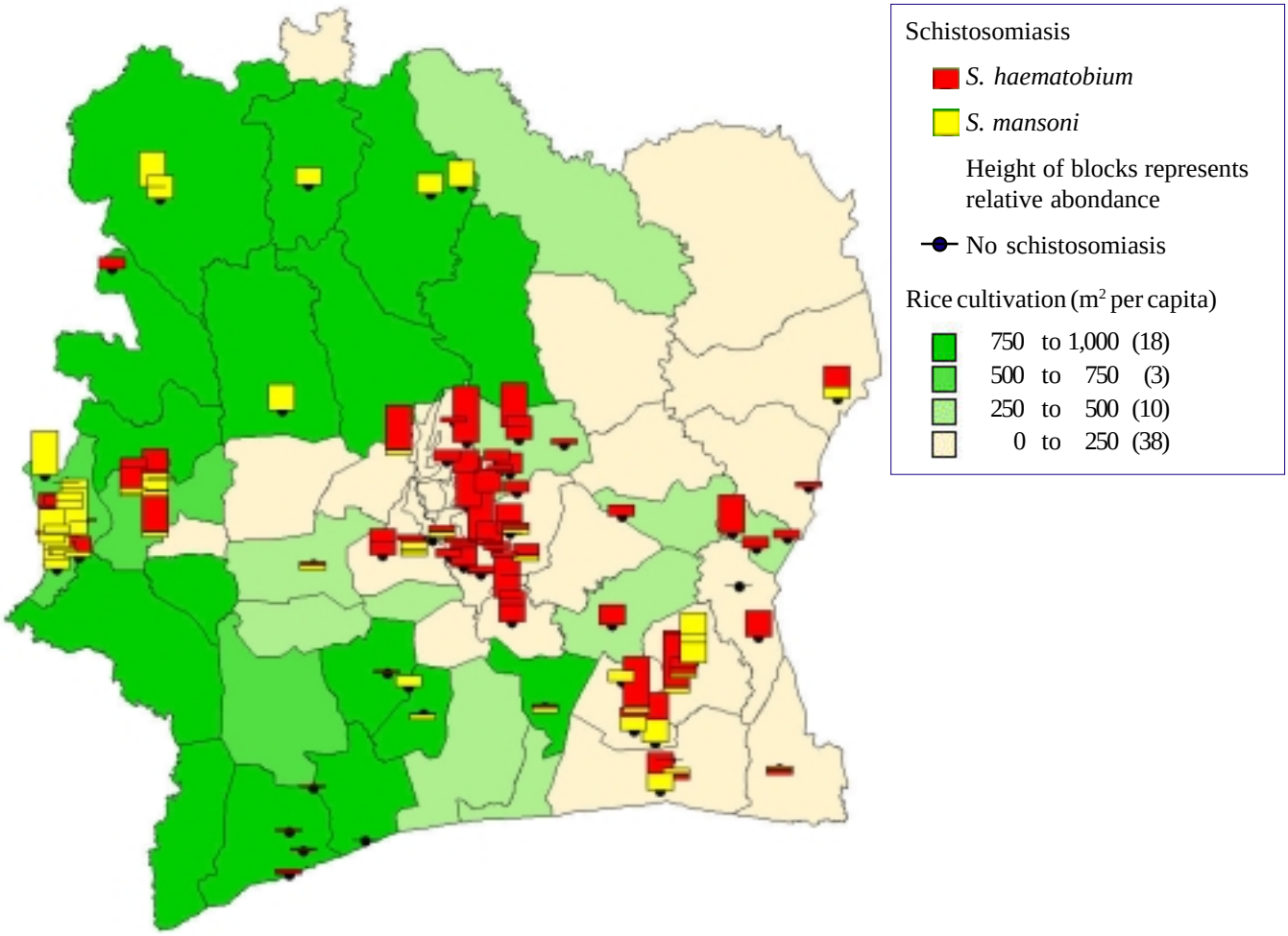


Figure 9. Distribution of schistosomiasis in Côte d'Ivoire

heavily infested—for example, some 80% of the children living by the lake that supplies drinking water to the Ivorian town of Katiola suffers from disease caused by *S. haematobium*.

Efforts to control the disease

In the past, disease-control efforts have concentrated on reducing the contact between people and infested water, mostly through improved sanitation and health education. Chemical control of snails is difficult and expensive. In East Africa, a plant was discovered that liberates a snail-toxic chemical when crushed or pounded; however, the chemical is also toxic to fish, and when attempts were made to introduce it as a means of snail control, it was instead adopted for fishing!

Schistosomiasis itself has proved easy to control with modern drugs, which are highly effective in a single-dose formulation and have minimal side-effects. Thus, it seems

simplest to manage the disease through a health-service based program of diagnosis and treatment, although reinfection is common in high-risk groups. In particular, school-based control campaigns have been successful—where they have been maintained.

Another potentially useful avoidance practice is the simple wearing of boots. Schistosomes are not the only nuisances in wetlands, farmers (and others) are also plagued by leaches, large snails, and an animal known as 'double-headed snake.' Boots protect the wearer from all of these. Migrant workers who opt for wearing boots do so to avoid these nuisances. However, in resource-poor farming communities, boots are considered a work tool, and one that is expensive; thus, with expenditure controlled by the head of household, it is only he (or exceptionally she) who is likely to possess them, leaving the rest of the household still at risk. In both the savanna and the forest, while men are usually the ones owning and wearing boots, most of the work in lowlands is done by women who do not have access to boots (a notable exception is migrant groups from Sahelian countries, where men are largely involved in lowland agriculture).

In addition to surveying for baseline data, the Human Health Consortium also looked for ways to control the spread of the disease. It hypothesized that, in large irrigation areas such as the *Office du Niger* with 70,000 ha of irrigated land, it should be possible to identify the vegetation types responsible for maintaining snails in contact zones, and therefore control the vector by vegetation clearance. Once such vegetation blocks could be identified, a series of removal experiments would be necessary to test the hypothesis; however, the work never got that far...

Native perceptions of disease

A major stumbling block made such intervention theories falter to the point that continuation of the work would have been a complete waste of effort. The problem is the perception that the native communities have of diseases.

There is a perception among rice-based rural farming communities in the humid forest and savanna of West and Central Africa that all diseases are already present in the body. It is perceived that 'risky behavior' causes diseases to become manifest, rather than such behavior increasing the likelihood of infection by an external germ (the scientific understanding). Furthermore, it is only in areas with high parasite infection rates that people actually identify schistosomiasis as a specific disease. Intestinal schistosomiasis is often associated with dysentery, and urinary schistosomiasis associated with sexually transmitted diseases among teenagers and adults. Even in areas where the disease is identified as such and is known to be associated with lowlands (in areas where large education campaigns have been undertaken), people usually associate the disease with the drinking of dirty water rather than with standing or working in the water. Thus, the 'risky behavior' may be coming into contact with water, but little or no value is attached to prophylactic measures, such as wearing boots or using latrines, even in areas where the disease is well known.

Schistosomes under the microscope

In addition, schistosomiasis is simply not perceived as life-threatening, or even as debilitating. This is due to the fact that many infected people do not suffer to any great extent. Urinary schistosomiasis is seen rather as a disease of adolescence—a sign that a child (particularly a boy) is growing into an adult. In 90% of infected individuals, 'red urine' is the only symptom of schistosome infection (*see* Box), and that occurs during late childhood (school age) and early adolescence.

Both intestinal and urinary schistosomiasis are easy to cure. The intestinal form requires laboratory analysis to differentiate it from either amoebic or bacterial dysentery, but then is treated by administration of a single dose of the appropriate anthelminthic drug. However, reinfection is very common, as exposure is usually continuous.

The fact that the disease is chronic and untreated 'red urine' in adolescence could lead to kidney failure at the age of 45–55 years is simply not known or acknowledged. For some reason, untreated intestinal schistosomiasis results in severe liver disease much less frequently in many parts of Africa than it does in some other continents.

Red urine (left, compared with normal urine, right)—often the only symptom of schistosomiasis

Schistosomiasis in West Africans

Schistosomiasis is a parasitic disease brought about by worms, known as schistosomes. There are two types of schistosomiasis which infect humans in West and Central Africa: urinogenital, caused by *Schistosoma haematobium*, and intestinal, caused by *Schistosoma mansoni*. In both cases, the disease is brought about by the body's immune reaction to worm eggs deposited in target-organ tissues, rather than by the schistosomes themselves. The immune system seeks to encase the deposited eggs, and it is the body's inflammatory response to the eggs that causes the disease symptoms.

Urinogenital schistosomiasis

Adult worms migrate through the venous blood system and eggs are deposited in the bladder wall. The inflammatory response to the worm eggs causes bladder-wall bleeding. This results in what is often the disease's only symptom, 'red urine.' As the worm eggs are encased close to the base of the urethras (urine-tubes), the urethras become blocked. With time, this blockage of urine outflow can extend back to the kidney and result in kidney failure, which is inevitably fatal if both kidneys are involved; however, this is unlikely to occur before the patient is 45 years old. In other cases, chronic bladder infection may eventually lead to cancer of the bladder. In populations where life-expectency is short, the chronic (long-term) effects of schistosomiasis infection are simply not apparent.

Intestinal schistosomiasis

Intestinal schistosomiasis is initially manifest as painful bloody dysentery, which usually leads to the patient (or their family) seeking medical advice and prompt curative treatment. The worm migrates through the venous blood system to the liver, where the ensuing worm-egg inflammation results in granuloma, which over time will destroy the normal liver tissue, leaving scar tissue and resulting in cirrhosis. Liver cirrhosis is again fatal; however, in most cases, either the disease is treated with the onset of diarrhea and dysentery, or else people die from other causes before the effects of liver failure or cirrhosis become manifest.

Lessons learned

The Health Consortium's work on schistosomiasis showed very clearly that community perceptions can have a marked effect on the success of scientific interventions. In theory, it should have been possible to identify vegeta-

tion types associated with schistosome-vector snails, but the lack of understanding of how the disease works would have meant that the suggestion of clearing appropriate vegetation to decrease the snail habitat would have gone unheeded. It is proving almost as difficult to persuade the farming communities involved in this research to adopt bed-nets as a means of preventing malaria, and that disease is a well-known killer! Thus, agricultural (and other development-oriented) research needs to look beyond its own sphere and take such fields as sociology into consideration when developing technology to improve the livelihoods of its clientele.

In contrast to the 'failure' of snail-control technology, the sociological surveys conducted by the Consortium, and others, have shown ways of improving the health status of farming communities. Where women achieve increased independence through income-diversification (that is, they have several sources of income, rather than just one agricultural crop), they are better empowered to take control of their families' health. While traditionally it is men who are in charge of all health-related expenses and decisions, in practice it is women who most often identify the medical needs of their family members, and when they have the financial resources to do so, they play an increasing role in the decision and choice of the medical treatment to seek. It has been shown that the families of women with diversified income sources have up to 40% fewer malaria episodes compared with those of women with undiversified income sources. Clearly, the more independent the woman concerned, the more financial decision-making freedom she has to obtain that help quickly. Thus, a simple prescription to improved farmer health is development projects that target the diversification of women's farming practices, and helping them to achieve greater financial autonomy.

Linking research with community development

Community-focused research represents a substantial time investment by participants and, consequently, there is a need for some sort of 'pay-off' or 'pay-back' that directly benefits the communities concerned. Many bio-medical research projects provide this in the form of short-term health care, with the medical personnel providing treatment for ailments when they visit the project site (or else making specific visits to provide such treatment). The Health Consortium decided to provide sustainable assistance to villages participating in its research activities in the savanna zone through support to the Ivorian Government's 'village revolving drug fund' strategy. The strategy aims at facilitating access to essential drugs in villages that have no formal health services (the majority of villages in Côte d'Ivoire). The Health Consortium provided the initial investment funds in the form of a complete drug kit for each participating village. The Consortium also helped establish appropriate management tools for the revolving fund at the community level. Once the kit is available, the villagers purchase from it and so a revolving fund is established to replenish supplies. One of the 12 villages involved with the Health Consortium won the Ministry of Public Health Prize for having successfully implemented the strategy, setting an example for other rural communities to follow.

Research activities also provide a suitable framework for training junior scientists. The Consortium's activities included postgraduate training (Masters and Doctoral levels) for 12 young scientists in Côte d'Ivoire and Mali. Three of these students received prizes from their universities for best thesis—a clear indication of the quality of the research conducted and support given to these young scientists.