

Health

AN ECOSYSTEM APPROACH

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Malaria and Agriculture in Kenya

A new perspective on the links between health and ecosystems

Malaria is thought to have emerged as a virulent disease at the same time as the early practice of agriculture — about 7,000 years ago. Today, a project supported by the International Development Research Centre is taking a new look at the links between agriculture and malaria. The goal is to reduce the incidence of the disease.



IDRC: Peter Bennett

Increased paddy flooding prolongs the mosquito breeding season.

Justus Mwangi is not working in the rice fields today. Instead, in the shimmering midday heat, he stands in the shade of a tree discussing his village's number one health problem — malaria. "You are disabled because you can't walk. It brings headaches and fatigue," says this slight village leader. Of the 53 families living here in Mbui-Njeru, Kenya, someone is always suffering from the disease.

Yet just behind Mwangi, quietly swatting flies with its tail, stands a possible weapon in the fight against malaria — a black and white cow. Research has shown that certain species of malaria-bearing mosquitoes prefer the blood of cattle to that of humans. As part of a larger investigation into malaria in Kenya's Mwea Rice Irrigation Scheme, researchers with the International Centre for Insect Physiology and Ecology (ICIPE) and the International Water Management Institute (IWMI) are exploring whether cattle could be used as "bait" to divert mosquitoes away from humans. Another potential strategy is to reduce mosquito breeding habitats by limiting the amount of water used for rice cultivation in the Scheme. The project is thus taking a novel approach to improving human health, focusing not on health care interventions but on better management of the agricultural ecosystem.

"The link between irrigated tropical agriculture and malaria is pretty convincing, so it makes sense to try to attack the problem at the source," says Dr Clifford Mutero, the entomologist who heads up the research team. The project is supported by the International Development Research Centre (IDRC).



IDRC: Peter Bennett

Through local research assistants, the project learns about community needs.

Colonial relics and malaria

The Mwea Rice Irrigation Scheme began as an internment camp for Mau Mau fighters rebelling against British colonial rule. This history has cast long shadows.

Many restrictive practices in the Scheme date from its origins. The farmers do not have land tenure, for instance, and live in tightly packed villages. Until recently, the government's National Irrigation Board (NIB) strictly regulated all aspects of rice cultivation — planting, harvesting, milling, and marketing. The NIB also provided all the agricultural inputs, which the farmers paid for with market earnings. Although they produce close to 80 percent of the rice consumed in Kenya, the farmers live in poverty.

"It's a life that does not give you any dignity," says Charity Kabutha, a sociologist who guided the project's participatory research. Women, in particular, reported many social problems in the communities. The seasonality of the work, plus the lump sum payments given to farmers, lead to periods of idleness when money is in hand. Moreover, the relatively recent settlement of the villages means there is little social cohesion. Kabutha says that these factors and the overriding poverty may contribute to the high rates of alcoholism and domestic violence in the Scheme.

In the late 1990s, violent clashes erupted between farmers and the NIB over the Scheme's undemocratic structure. The farmers subsequently formed a cooperative to take over many of the NIB's management functions. But while farmers have assumed greater control, the resulting changes could increase malaria.

"When the government was in charge, the schedule for rice cultivation was very well defined," says Dr Mutero. "It was much easier to know the exact time for interventions to protect people against mosquitoes." Farmers now plant rice whenever they want. There are consequently submerged paddies year-round, prolonging the mosquito breeding season.

Driving along the rough, dusty roads of the Scheme, Dr Mutero also points out "informal" cultivation of rice. Some farmers have diverted water and are growing rice on land that could be used for grazing cattle. Malaria transmission could increase if the cattle population was to drop.

Unfortunately, the farmers' cooperative has neither the resources nor the capacity to undertake all the work required to run the Scheme effectively. "The farmers are rebelling against a system but they haven't found a better one," says Charity Kabutha. "It's an institutional setup gone awry."

Labour camp origins

Efforts to grow irrigated rice in Mwea, located about 100 kilometres northeast of Nairobi, began under British colonial rule. But it was not until the British turned the area into a detention camp for captured Mau Mau fighters in the 1950s that rice could be cultivated there on a wide scale. The detainees were forced to dig canals, build dams, and work in the paddies. With independence in 1963, the new government took over the Scheme and settled landless peasants there; they worked and lived alongside the ex-freedom fighters. Today more than 3,000 families live within the Scheme, which covers 13,640 hectares.

About half of these hectares are devoted to rice cultivation, irrigated by water that flows down the slopes of Mount Kenya. The paddies are submerged for at least six months of the year, providing an ideal habitat for mosquitoes. One species of these mosquitoes — *Anopheles arabiensis* — carries malaria. Approximately 20 percent of community members have malaria parasites in their blood at any one time.

Like elsewhere in Kenya, where between 75 and 100 children die every day from malaria, conventional efforts to control the disease have not worked. Malaria parasites are increasingly resistant to the drugs that treat the disease and the mosquito vectors to the insecticides that are meant to prevent it. These control methods are also expensive for the Mwea farmers, who are lucky if they earn US \$500 a year. Villagers interviewed during the project all identified malaria as their main health problem. In searching for new lines of attack, Dr Mutero and his team are using the ecohealth approach to understand the complexity of factors that influence malaria transmission in Mwea. [See box on back panel: *Ecosystem Approaches to Human Health*]

The approach can be compared to using a camera with a zoom lens. The zoom brings the problem into sharp focus — in this case, a mosquito infecting a person with malaria. As the lens pulls back, other elements are brought into the picture: poverty in the villages; farming practices in the rice fields; men sitting idle while their wives work. In short, this "wide-angle" view helps researchers to determine the reasons behind the malaria statistics and to develop possible interventions. "To be relevant to the communities, one has to strive to see the big picture beyond the research issue that took you to the field," says Dr Mutero. "The beauty of the ecosystem approach is that it enables you to capture the big picture."

Community involvement

Relevance to the community is at the heart of the ecosystem approach, beginning with the active participation of community members in the research process. In Mwea, villagers were involved in all phases of the project. An initial workshop in January 2001 brought together participants from 17 organizations, including government, the rice growers' association, church groups, and community-based organizations. The group worked

to understand people's perceptions of the health and development problems in the rice Scheme. Based on these consultations, four villages were chosen for further study.

The next step was to compile an "inventory" of information about life in these villages, as described by the villagers themselves. To help in this process, and to further ground the research in the communities, the project hired and trained 10 local people to work as research assistants. The project team then used a battery of tools and techniques to assess the communities, gathering such basic information as age, sex, education, income, occupation, family size, nutritional status, religious and cultural affiliations. The team also learned about broader issues, such as health problems, poverty, social ills, and conflict in the rice Scheme. Throughout the research, careful consideration was given to the different roles and responsibilities of women and men — in the home, in the community, and in the rice fields.

Members of the community shared their knowledge through varied means: drawing maps on clean-swept earth; describing key events in village life over the last decade; and discussing problems individually or in focus groups. Women and men were often interviewed separately so they could freely air their views. "We allowed them into our interior environment," says Justus Mwangi of the researchers.

Broad research program

It was only after this extensive work in the community had been completed that other lines of research began. The project has documented and assessed the crop and livestock production systems and how these relate to peoples' health. Researchers have also experimented with ways to reduce the mosquitoes' wet habitat by introducing a crop that grows in dry conditions and by cultivating rice with less water. More traditional research activities included collecting mosquitoes in households in the early morning hours. Those insects that had dined on blood were preserved to determine the source of their meal — human or livestock. To assess the prevalence of malaria in the villages, researchers analyzed blood samples from children.



IDRC: Peter Bennett

Researchers collect mosquitoes to determine the source of blood "meals".

The nature and breadth of the research reflect another defining characteristic of ecohealth research — transdisciplinarity. No single scientific discipline can address the myriad factors that influence malaria and its transmission in Mwea. For example, political conflict in the Scheme is affecting people's health and wellbeing. [See box: *Colonial relics and malaria*] This complex issue, like others related to the project, demands the attention of several specialists to be properly understood. Accordingly, eight disciplines are represented in the core project team, composed of a medical entomologist, a medical parasitologist, a public health expert, a crop/livestock expert, a veterinarian, an anthropologist, a sociologist, and a statistician. Three team members are women.

The specialists initially collaborated on defining the problems to be addressed; they then decided how their knowledge and expertise could be integrated into a research program. Such transdisciplinary research usually means moving outside the confines of one's particular discipline. "If you are the best in your field, it's not good enough," says Jean-Michel Labatut, a senior program specialist with IDRC's Ecosystem Approaches to Human Health program initiative. "You have to have an open mind."

Possible solutions

Similarly, there is no "one-size-fits-all" intervention that can address all facets of the malaria problem in Mwea. "It's not high-tech solutions that are necessarily needed here, but rather solutions that address the general environment of the people — both socioeconomic and biophysical," says Dr Mutero. The project has proposed an integrated series of such interventions for Mwea:

Improved water management

Reduce the amount of time that paddies are wet, either by changing flooding schedules or alternating rice cultivation with a dry-land crop such as soya. In addition to limiting the mosquitoes' habitat, planting soya could boost income and improve nutrition in the Scheme. Children in Mwea often suffer from protein deficiencies, says Dr Mutero because "it's rice for breakfast, rice for lunch, and rice for dinner."

Livestock as bait

Maintain the current cattle population by utilizing rice husks, which are ordinarily burned as waste, as animal feed. The cattle would divert the blood-seeking mosquitoes away from humans. Preliminary research found that the village with the highest



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Cattle could help reduce malaria by diverting mosquitoes away from humans.



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Mwea villagers see malaria as their main health problem.

number of mosquitoes per household had the lowest prevalence of malaria. It was also the village with the highest livestock population.

Biological control

Introduce naturally occurring bacteria into stagnant water to kill mosquito larvae during the peak breeding season. Such biological control agents would be harmless to humans and other animals.

Mosquito nets

Provide insecticide-treated bednets to groups at high risk for malaria, namely young children and pregnant women, through partnerships with nongovernmental organizations (NGOs). Nets

are expensive for farming households but NGOs could help offset the costs.

The researchers are now looking ahead to a possible second phase when some of these interventions could be introduced. The lessons from the project are also being carried forward by the System-wide Initiative on Malaria and Agriculture (SIMA), a new consortium formed by the Future Harvest Centres of the Consultative Group on International Agricultural Research. SIMA's goal is to show, through research and capacity-building, that communities can adopt numerous agricultural practices to reduce and prevent malaria. The ecohealth approach is central to much of its work. Fittingly, Dr Mutero is coordinating SIMA, based at the IWMI Regional Office for Africa in Pretoria, South Africa.

"During my earlier academic training, I did a lot of work on mosquito ecology and behaviour," says Dr Mutero. "By the time I had done 15 years of that, I realized that many of the things I was doing were almost irrelevant to the people I was trying to help. When you get to my stage in life, you want to do something that is of practical relevance.... It makes sense to embrace this holistic approach to solve problems."

This *Case Study* was written by Jennifer Pepall, a writer in IDRC's Communications Division.

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For more information:

Clifford Mutero

CGIAR Systemwide Initiative on Malaria and Agriculture (SIMA)
International Water Management Institute (IWMI)
141 Cresswell Street Silverton 0184
Private Bag X813
0127 Silverton
Pretoria, South Africa

Tel: +27 12 8459100
Fax: +27 12 8459110
Email: c.mutero@cgiar.org
Web: www.iwmi.org



Ecosystem Approaches to Human Health Program Initiative
International Development Research Centre
PO Box 8500, Ottawa, ON
Canada K1G 3H9

Tel.: +1 (613) 236-6163
Fax: +1 (613) 567-7748
Email: ecohealth@idrc.ca Web: www.idrc.ca/ecohealth

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Ecosystem Approaches to Human Health

Human health and well-being are intimately tied to the health of the ecosystems that sustain life. Yet the potential for improving health by better managing the local environment is an avenue rarely explored in mainstream health programming. Through its Ecosystem Approaches to Human Health (Ecohealth) Program Initiative, IDRC aims to identify the web of economic, social, and environmental factors that influence human health. Communities can then use this knowledge to better manage ecosystems and improve the health of both people and the ecosystem.