Tackling sleeping sickness in Maasai communities

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Tsetse fly. Credit: International Atomic Energy Agency.

Pietro Ceccato remembers his first trip three years ago to a Maasai village located a two hour's drive south of Arusha, Tanzania. He was there with a team of public health researchers to learn more about the dynamics of trypanosomiasis, a parasitic disease carried by tsetse flies which threatens millions of people in communities across sub-Saharan Africa.

What he remembers most from that trip, however, was what some of the community members held in their hands.

"Smart phones, which I thought was remarkable given the remoteness of the location and the minimal infrastructure," he says.

Ceccato is a remote sensing expert at Columbia University's

International Research Institute for Climate and Society. He develops tools based on IRI's Data Library and Google Earth Engine to visualize massive climate and environmental data sets derived from satellites along with on-the-ground disease surveillance data. His goal is for these tools to improve public health decision making and thereby lower the risks of infection and transmission of trypanosomiasis and other diseases.

Human African trypanosomiasis, better known as sleeping sickness, occurs in 36 sub-Saharan countries, disproportionately affecting those who live in remote rural areas and base their livelihood on raising animals, such as the pastoralist Maasai. People get sick primarily from the bites of certain tsetse fly species. Symptoms of those infected can initially be flu-like, but if left untreated the disease progresses to the central nervous system and is fatal. (Another form of trypanosomiasis known as Chagas disease occurs in Latin America, but it's transmitted by a different bug.)

According to the World Health Organization, trypanosomiasis infections have decreased sharply in the last decade. WHO estimates the number of annual cases now to be well below 20,000. However, the distribution of tsetse flies overlaps with land that 65 million people call home. Population displacement, wars, poverty and perhaps changing climate conditions keep the threat of infections and epidemics a concern to health officials.

Trypanosomiasis also occurs in forms that infect animals, including cattle, the primary source of food and income for the Maasai, for whom milk is a staple food. Infected animals are weaker, have a reduced growth rate and produce less milk. Most eventually die as a result of infection. Locally, this causes financial and nutritional hardship in Maasai communities. Across the whole of sub-Saharan Africa, cattle deaths from trypanosomiasis can cause billions of dollars of production

and economic losses.

In those smartphones, Ceccato recalls, he saw the potential to bring powerful information directly into the hands of the Maasai, so they could take action to reduce their chances of coming into contact with infected flies.

"My goal was to see if we could bring the monitoring power of NASA satellites in space down to a village level," he says.

Three years later, thanks to funding from NASA-SERVIR, the World Health Organization and the International Development Research Centre, Ceccato and his collaborators have achieved that goal.

In 2014, WHO's Special Programme for Research and Training in Tropical Diseases (WHO-TDR) asked Ceccato to see how climate and environmental information could be used in the effort to reduce infection risk of trypanosomiasis.

As with mosquito-borne malaria, Zika and dengue, the trypanosoma parasite depends on an insect vector to survive and spread.

"We were fairly sure that temperatures and other environmental conditions have an impact on tsetse populations," Ceccato says. "And so we set out to understand how changes in these variables as well as habitat might affect the transmission of trypanosomiasis."

Such an understanding, the reasoning went, would lead to better targeting of spraying with insecticides and other measures to control the fly population.

Ceccato worked with researchers at the Nelson Mandela African Institute of Science and Technology (NMAIST) in Arusha, Tanzania,

who travel regularly to rural areas to locate and trap flies and look for the presence of the parasite in order to determine infection rates.

He mapped their data along with Landsat images and other information using a prototype platform that he developed using Google Earth. The satellite images allow him to see changes in vegetation and water bodies at extremely high resolution. He and his colleagues can then compare these changes to changes in tsetse fly locations.

Animal herds will travel to areas where there's water, and, unfortunately, where the tsetse flies are waiting. "The flies seek shade and shelter in trees during the hottest parts of the day," Ceccato says. "They fly to the water bodies in the morning and evening to bite animals that are drinking, as well as any people who are there with them."

Ceccato also incorporated rainfall and temperature data as well as a vegetation index to analyze the impact of these variables on the movements and distribution of the flies over many months.

"When we first discussed this project, we were excited about the idea of having a mapping interface product for decision making and for preparedness programs that addresses vector-borne diseases and climate change," says WHO-TDR's Bernadette Ramirez. "It's great to see that this idea is now a reality!"

Using this platform, members of the Maasai community will be able to identify grazing and drinking areas free from populations of infected tsetse flies. This is especially critical during the dry season, when drinking holes are scarce.

The fly data will also help authorities target where to spray insecticides to control the population of these biting insects.

"Now the research communities, pastoral Maasai communities, and any other interested parties can access environmental and health information easily in way that was never before possible," Ceccato says.

This summer, his research partner Paul Gwakisa, from NMAIST and the Sokoine University of Agriculture, revisited that original Maasai village to demonstrate the tool to community leaders and discuss the various kinds of decisions they could make based on the online maps.

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