Top: Training pupils on identifying mosquito larvae in Nyabondo, near Kisumu, Kenya.

Bottom: Biopesticides efficacy trials in Tolay, Ethiopia.

Mass trapping is being done using the 'Suna' trap, derived from the Luo language name for mosquito. *icipe* and partners from Wageninegn University and Research Centre (the Netherlands) and BiogentsAG (Germany) developed the trap.

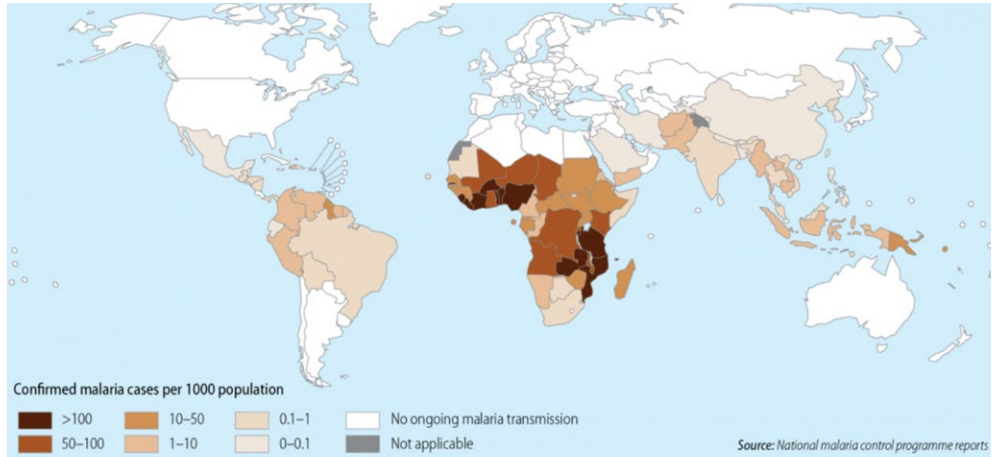
The traps, which operate on electric power, are charged by solar power systems installed on house roofs. The installation of solar-powered mosquito trapping systems (SMoTS) on Rusinga Island by the SolarMal Project commenced in June 2014 and ended in May 2015. The proof-of-principle phase of the project will end in December 2015 after the project has installed >4200 solar powered mosquito traps (SMoTs). Besides public health importance, SMoTS are also used for socio-economic empowerment of the community, providing lighting and charging of mobile phones.

We hope that by removing a fraction of the mosquito population every day, the number of mosquitoes in the environment will reduce, and people will receive fewer bites. As people receive fewer bites, the risk of being infected with malaria will reduce, and so will the risk of passing on malaria to a mosquito.

Top: An irrigated rice field near Ahero town in western Kenya. The shallow waters present a breeding ground for malaria-transmitting mosquitoes belonging to the *Anopheles gambiae* complex.

Bottom: MalariaSphere used for semi-field experiments at night.

Malaria distribution in 2015



97 countries with ongoing transmission; 90% of malaria burden in Africa

***icipe* – Working in Africa for Africa…**

icipe – African Insect Science for Food and Health – was established in 1970 in response to the need for alternative and environmentally friendly pest and vector management strategies. Headquartered in Nairobi, Kenya, *icipe* is mandated to conduct research, and develop methods that are effective, selective, non-polluting, non-resistance inducing, and which are affordable to resource-limited rural and urban communities. *icipe*'s mandate further extends to conserving and utilising the rich insect biodiversity found in Africa.

icipe recognises that an increase in productivity can only occur with a healthy workforce, as sick people cannot be active in economic development. It is a well known that farmers suffering from malaria cultivate 60% less land than their healthy counterparts. The Centre, therefore, focuses on improving the health of people in sub-Saharan Africa, so that they can play the role in society, and the economy, that they deserve to play.

COVER PHOTOS

Top left: Malaria mosquito engorged with human blood.

Top right: Technicians installing a solar panel for powering a mosquito trap on Rusinga Island.

Bottom left: *Anopheles* larva.

Bottom right: A young child suffering from malaria.

DONORS: National Institutes of Health (NIH), USA; International Development Research Centre (IDRC), Canada; Biovision, Switzerland; Federal Ministry of Education and Research (BMBF) Germany; Foundation for the National Institutes of Health, USA; COmON Foundation, The Netherlands; European Union; WHO-AFRO; UNEP/Global Environment Facility (GEF); The Bill & Melinda Gates Foundation (USA).

COLLABORATORS: Kenya Medical Research Institute (KEMRI); University of Nairobi, Kenya; Jomo Kenyatta University of Agriculture and Technology, Kenya; University of Illinois, USA; University of Miami, USA; University of California, USA; Pennsylvania State University, USA; Duke University, USA; International Water Management Institute (IWMI), Sri Lanka; Wageningen University and Research Centre, The Netherlands; Radboud University Medical Center, Nijmegen, The Netherlands; The Royal Dutch Institute of Tropical Medicine (KIT), The Netherlands; University of Pretoria, South Africa; Kilimanjaro Christian Medical Centre (KCMC), Tanzania; National Institute of Medical Research (NIMR), Tanzania; London School of Hygiene and Tropical Medicine (LSHTM), UK.

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icipe
African Insect Science for Food and Health

International Centre of Insect Physiology and Ecology (*icipe*)
P. O. Box 30772-00100 Nairobi, Kenya
icipe@icipe.org — www.icipe.org

Managing Malaria

Empowering Communities to Power Africa

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African Insect Science for Food and Health

Malaria control

The past decade has seen enormous investments in the war against malaria. Vector control is among the key strategies that have contributed to a significant reduction in malaria illness and deaths in a number of African countries during this period. This achievement is attributed to the scaling up of two interventions—use of longlasting insecticide-treated mosquito nets (LLINs), and indoor residual spraying (IRS)—both of which use insecticides.

The final UN 2015 millennium development goals (MDG) Report published in 2015 states that "a reversal in malaria incidences has been realised ... primarily of children under the age of five in sub-Saharan Africa". The growing importance of outdoor transmission of malaria is one tactic to managing malaria in the post-2015 development agenda, because the emergence of insecticide resistance among many malaria vector populations could undermine the gains in malaria control. According to WHO, insecticide resistance has now been identified in 64 countries, most of them in sub-Saharan Africa. In some areas the resistance is widespread, and has been reported for all classes of insecticides that WHO has approved for public health use. Besides, overreliance on

Left: Youth group engaged in environmental management for malaria IVM in Nyabondo, Kenya.

Top: Community members receiving training on sampling of mosquito larvae from breeding sites in Tolay, Ethiopia.

Bottom: *icipe* malaria team members using a leaf funnel to collect mosquito larvae for establishing a colony at the Centre's Duduville Campus in Nairobi.

synthetic insecticides to control mosquitoes is unsustainable due to potential negative impacts on human health and the environment. Moreover, the future of costly vertical malaria programmes relying on insecticides is bleak, as the funding declines due to the economic recession pervading some of the developed countries that support malaria control in Africa.

icipe, therefore, believes the prerequisites for reducing malaria in Africa are a thorough understanding of the mosquito vector, and improving access to information on how to prevent and break the malaria transmission cycle. As there is no single solution for malaria, the Centre is also involved in basic research to develop new innovative tools and approaches to mosquito control. The research focuses on attractants/repellents of host seeking mosquitoes, implementing birth control in mosquitoes, the phenomena modulating malaria vector competence, oviposition behaviour of malaria mosquitoes, plants that act as energy sources for mosquitoes, and so on.

IVM for sustainable malaria control in eastern Africa: Why IVM?

In an effort to avert a possible future collapse of malaria control programmes, the World

Right: When fishing boats are not in use, fishermen must put water in idle fishing boats to avoid cracking of the wood, which creates mosquito-breeding sites.

Top: SolarMal community engagement staff training Rusinga residents on how to use Solar-powered mosquito trapping system (SMoTS) for malaria control.

Bottom: New mosquito containment facility.

Health Organization and the international malaria control community are promoting integrated vector management (IVM) as a sustainable malaria vector control method. IVM entails using a variety of methods, and avoid relying on a single method; for instance, combining non-chemical methods (such as environmental management) with chemical methods (such as the use of LLINs). The main purpose of IVM is to improve the efficacy, cost-effectiveness, ecological soundness, and sustainability of vector control, to prevent, or interrupt disease transmission.

icipe's IVM experience

icipe engages multiple stakeholders and communities in collaborative research, with the goal of controlling malaria in the context of IVM. Towards this end, *icipe* has been demonstrating the impact of IVM in Malindi and Nyabondo—in coastal and western Kenya, respectively—and in Tolay within the Ghibe Valley in Ethiopia. Other sites include Rusinga, Ngodhe and Mageta Islands in Lake Victoria, Kenya. Vector control methods evaluated and promoted in the former three demonstration sites include environmental management combined with the use of eco-friendly larvicides, such as *Bacillus thuringiensis israelensis* (Bti), neem, and other plant-derived biopesticides. Effectiveness

of the IVM approach is being tested in different ecological and epidemiological settings. This type of evidence is crucial, and a prerequisite to the scaling up of IVM in Africa, which is a continent that exhibits significant variations in malaria burden, because of the diverse socio-ecological conditions, within and among different countries.

The IVM programme at *icipe* is focusing on scaling up community-based malaria control, and promoting IVM-related income-generating activities. At the same time, *icipe* is promoting IVM at the national malaria control programmes (NMCPs) level, through advocacy and engagement with policy makers in the health and related sectors, such as agriculture, water, and environment.

Innovative use of solar power for mass trapping of mosquitoes, and eliminating malaria

Scientists at *icipe* and their collaborators have developed a novel odour-baited mosquito trapping system capable of attracting more malaria-transmitting mosquitoes than a human does. The technology circumvents use of insecticides, and has provided a key breakthrough towards creating a mass trapping system for malaria control.