Environment

Re-thinking the relationship between rice and malaria

Rice fields in Africa are major breeding sites for malaria vectors. However, reviews conducted in the 1990s revealed that communities with irrigated rice fields did not necessarily have more malaria. Since then, intervention coverage has been massively scaled up and malaria prevalence has halved. This calls for a re-examination of the rice-malaria relationship.

A systematic review and meta-analysis were conducted on observational studies that compared malaria epidemiological and entomological outcomes between people living in rice-growing and non-rice growing communities in sub-Saharan Africa. This study looked at whether the decline in malaria transmission has changed the associations between rice cultivation and malaria risk.

It was confirmed that before the year 2003, malaria prevalence was not higher in rice-growing communities. However, after 2003, it was almost two times higher in rice villages. It was also confirmed that as underlying malaria intensity decreased, there was an increase in the strength of association between rice cultivation and malaria risk.

As rice cultivation brings increased malaria risk, expansion of irrigated rice production may interfere with plans for malaria elimination in sub-Saharan Africa.

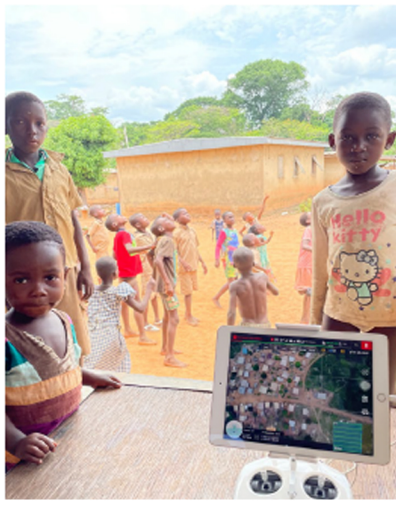
The impact of global environmental change on mosquito-borne disease

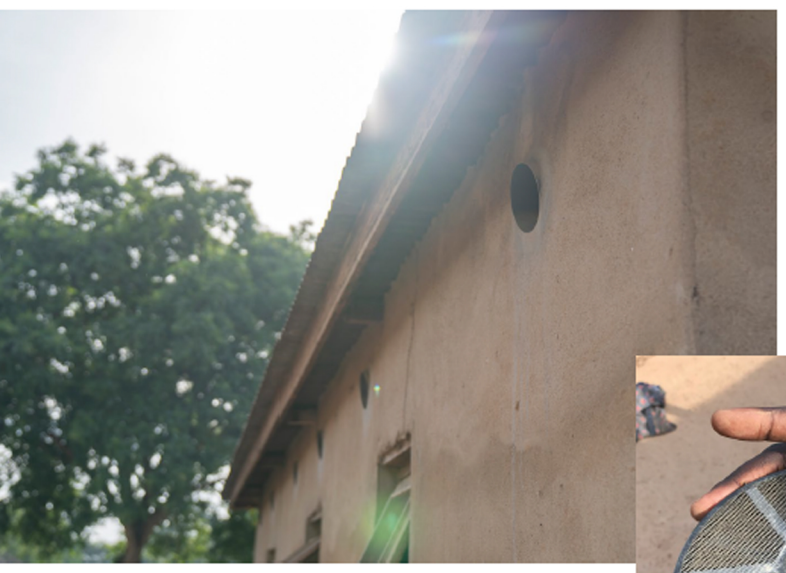
Anthropogenic pressures on the Earth can have devastating consequences for human health, including an increased threat of mosquito-borne diseases. There is a growing need to understand the joint impact of climate variation and land-use change on mosquito-borne diseases, in conjunction with socioeconomic factors and vector control.

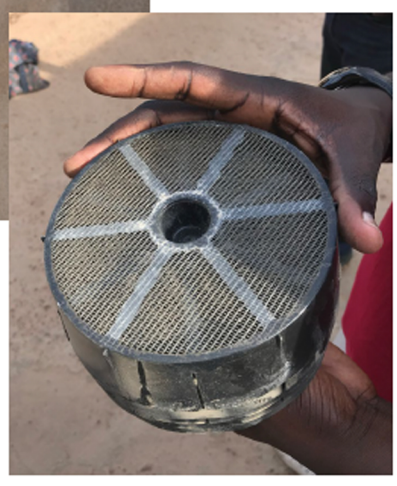
The studies used models informed by remotely -sensed environmental data to assess the spatiotemporal variation of mosquito-borne diseases in Ecuador and Venezuela. Different sources of climate data were compared to assess their impact on the models, and mosquito biodiversity was modelled across different land-use types in Latin America and the Caribbean.

There was a difference in the effectiveness of control measures and the impact of climate variation on the two malaria parasites, *P. falciparum* and *P vivax*, in Ecuador. In Venezuela, the effect of temperature on malaria incidence was amplified in areas degraded by mining activity. Further, there were declines in mosquito biodiversity in areas altered by human activity.

This project advances knowledge of how climate variation, land-use change, and socioeconomic factors interact to determine mosquito-borne disease risk, which can inform disease control activities.







Lethal house lures reduce malaria case incidence by 40% in Côte d'Ivoire

Malaria transmission remains unacceptably high in areas of Central and West Africa, despite high coverage of insecticide treated nets. New tools with different modes of action are required to further reduce the malaria burden.

In a large cluster randomised control trial in Côte d'Ivoire, house screening and insecticide-treated Eave Tubes were installed in 3000 houses to both prevent mosquitoes from entering houses and to reduce mosquito populations through killing them via insecticide. Malaria transmission metrics were compared between villages with the intervention and villages where only bed nets were used.

Malaria case incidence was reduced by 40% in children living in clusters where the interventions were fitted, compared to those living in clusters only using bed nets. The numbers of mosquitoes found indoors were reduced by 61%. The impact on malaria case incidence was higher in villages where the coverage of the intervention was higher and those living in intervention villages, but without the intervention, also appeared to benefit from the effects. The combined intervention was similarly cost-effective to other core vector control interventions in sub-Saharan Africa.

With human populations expanding across the world, building protective measures into new houses will be an important intervention in the arsenal of tools to reduce malaria.

Land use change and zoonoses – the case of *P. knowlesi* malaria

P. knowlesi, the most common malaria in Malaysia and found elsewhere in SE Asia, can be fatal if not treated. Environmental and land use changes are bringing the parasites' natural hosts, macaques, into close human contact, thus increasing the risk of infection. It is important that the drivers of risk are understood to prevent spread of zoonotic infections.

A combination of epidemiological, entomological and primate surveys were conducted in Malaysian Borneo in areas where detailed land cover was assessed with remote sensing and drones. This project used laboratory assays to assess exposure to, and infection with, *P. knowlesi*, and modelled the risk of infection from environmental, human, and macaque movement, and epidemiological data.

Results demonstrated environmental and habitat change influences the presence of mosquito vectors and macaque hosts to increase the potential risk of zoonotic malaria to humans. Conventional malaria control methods offer some protection, but novel approaches are required. However, data reviews and modelling suggest the likelihood of sustained human to human transmission is very low.

Controlling *P. knowlesi* malaria will require a multisectoral approach which could provide the basis for control of other existing and emergent zoonotic infections.

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