FACT SHEETS ON MALARIA AND THE SDGs

One of a series of fact sheets to accompany the Briefing Paper
Lessons learned from responding to malaria globally: A prototype for sustainable development

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CLIMATE CHANGE AND MALARIA

INTRODUCTION

Weather and climate are major determinants of the geographical distribution, seasonality, year-to-year variability and longer term trends of malaria**.** Periods of long-term drought can reduce transmission. Periods of unusually high rainfall, altered humidity or warmer temperatures can result in modified distribution and duration of malaria, as well as increased transmission, even in areas where control is strong. Natural climate variability – including the El Niño phenomena and other long-term meteorological cycles – are important not only in explaining trends in disease burden but also periodic upsurges in cases, including atypical epidemics.[1,2]

The Intergovernmental Panel on Climate Change (IPCC) has concluded that anticipated changes in temperature and rainfall will affect the natural habitats of mosquitoes, changing the prevalence of the vector or prolonging transmission seasons (or both) in some areas, and potentially exposing new regions and populations to malaria and other vector-borne diseases.[3]

Seen in this light, climate change has the potential to intensify the global burden of certain diseases, including malaria, and reverse interrelated developmental gains. The World Health Organization and the World Meteorological Organization have identified malaria as one of the most climate-sensitive diseases, with a wealth of evidence suggesting significant associations between changes in temperature, rainfall and humidity and malaria incidence.

Temperature rises (associated with current rates of carbon emission) of just 2–3 degrees Celsius could increase the number of people who are vulnerable to malaria by up to 5%, representing several hundred million people.[4] According to the IPCC, without additional measures to reduce greenhouse gas emissions (mitigation) the Earth is on the way to a temperature increase of 3.7–4.8 degrees Celsius.[5] A **World Bank** report indicates that by 2050, climate change may threaten some previously unexposed regions of South America, sub-Saharan Africa and China causing a 50% higher probability of malaria transmission.[6]

Roll Back Malaria's *Action and Investment to Defeat Malaria, 2016–2030* highlights the linkages between climate and malaria in the Sustainable Development Goals (SDGs). It stresses the need to build alliances between malaria programmes, ministries of health and relevant environmental and development partners (including national meteorological agencies) to secure access to climate adaptation funds.[7] It also calls for national malaria programmes to integrate the management of climate-related risks into their programme activities. For example, Botswana has established an early warning system that integrates a seasonal rainfall forecast with population and health surveillance information. This has enabled a reduction of up to four months in the time needed to respond to the warning of malaria epidemics.

1 Van Lieshout, M., Kovats, R. S., Livermore, M. T. J. & Martens, P. Climate change and malaria: analysis of the SRES climate and socio-economic scenarios. Glob. Environ. Change 14, 87-99 (2004).

2 Noor, A. M. et al. The changing risk of Plasmodium falciparum malaria infection in Africa, 2000-10: a spatial and temporal analysis of transmission intensity. Lancet 383, 1739-1747 (2014).

3 Further Reading: http://www.rollbackmalaria.org/about/multisectoral-action-framework/library [Environment and Climate]

4 World Meteorological Organization & World Health Organization. Factsheet #2: Climate information for protecting human health (2009). <http://www.who.int/globalchange/mediacentre/ events/2011/wcc3_factsheet2_health_en.pdf>

5 "Without additional efforts to reduce GHG emissions beyond those in place today, emissions growth is expected to persist driven by growth in global population and economic activities. Baseline scenarios, those without additional mitigation, result in global mean surface temperature increases in 2100 from 3.7 °C to 4.8 °C compared to pre-industrial levels". IPCC (2014) Summary for Policy Makers. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the IPCC.

6 The Potsdam Institute for Climate Impact Research and Climate Analytics, 'Turn-down the Heat – Why a 4 degree Warmer World Must be Avoided,' International Bank for Reconstruction and Development and World Bank, Washington, DC, 2012.

7 International Research Institute for Climate and Society. Enhancing national climate services maximizing the impact of malaria investment in a varying climate. <http://iri.columbia.edu/wp-content/uploads/2013/07/ENACTS_Health_Oct2014.pdf>

CASE STUDIES

Climate change adaption to protect human health[8]

Between 2010 and 2014 WHO carried out a climate change and human health adaption project in six pilot countries. In **Kenya**, the project sought to identify and share solutions to address health risks exacerbated and caused by climate change and variability. Projected results will be compared to the actual findings and should offer light on ways to measure the connection between climate change and malaria globally.

Using climate information for malaria risk management in Sri Lanka[9]

In collaboration with the **Sri Lanka** Ministry of Health and other government research partners, the International Research Institute for Climate and Society (IRI) and the International Water Management Institute (IWMI) undertook a project to characterize climate and malaria linkages in Sri Lanka, focusing initially on Uva province in the south-eastern part of the island. The goal was to use climate information for early warning of disease risk. Their analysis clearly showed evidence of climatic influence on malaria, both spatially and temporally. Malaria is linked to both the El Niño phenomenon and climatic change. As there is considerable spatial and epochal heterogeneity in the climate and malaria linkage, carefully calibrated, fine-scale warning systems are needed.

The impact of regional climate change on malaria risk due to greenhouse forcing and land-use changes in tropical Africa[10]

This study assessed potential changes in the malaria transmission via an integrated weather–disease model and concluded that climate changes driven by greenhouse-gas and land-use changes will significantly affect the spread of malaria in **tropical Africa** well before 2050. The geographic distribution of areas where malaria is epidemic might have to be significantly altered in the coming decades.

Assessment of patterns of climate variables and malaria cases in two ecological zones of Ghana[11]

A better understanding of the relationship between rainfall patterns and malaria cases is required for effective climate change adaptation strategies involving planning and implementation of appropriate disease control interventions. This paper analyzed climatic data and reported cases of malaria spanning a period of eight years (2001 to 2008) from two ecological zones in **Ghana** (Ejura and Winneba in the transition and coastal savannah zones respectively), to determine the association between malaria cases, temperature and rainfall patterns and the potential effects of climate change on malaria epidemiological trends. The results suggest maximum temperature as a better predictor of malaria trends than minimum temperature or precipitation, particularly in the transition zone. Climate change effects on malaria caseloads seem multi-factorial. For effective malaria control, interventions could be synchronized with the most important climatic predictors of the disease for greater impact.

Development and validation of climate and ecosystem-based early malaria epidemic prediction models in East Africa[12]

Malaria epidemics remain a serious threat to human populations living in the highlands of **East Africa** where transmission is unstable and climate sensitive. An existing early malaria epidemic prediction model required further development, validations and automation before its wide use and application in the region. The model has a lead-time of two to four months between the detection of the epidemic signal and the evolution of the epidemic. The validated models would be of great use in the early detection and prevention of malaria epidemics. The additive and multiplicative models were validated and were

8 http://www.who.int/globalchange/projects/adaptation/en/index6.html

9 Using climate information for malaria risk management in Sri Lanka. (http://iri.columbia.edu/wp-content/uploads/2013/07/SRILANKA.pdf)

10 The impact of regional climate change on malaria risk due to greenhouse forcing and land-use changes in tropical Africa. Environmental Health Perspectives. 2012; 120:77–84. (http://ehp.niehs.nih.gov/1103681/)

11 Assessment of patterns of climate variables and malaria cases in two ecological zones of Ghana. Open Journal of Ecology. 2014; 4:764–775. (http://dx.doi.org/10.4236/oje.2014.412065)

12 Development and validation of climate and ecosystem-based early malaria epidemic prediction models in East Africa. Malaria Journal. 2014; 13:329.

shown to be robust and with high climate-based, early epidemic predictive power. They are designed for use in the common, well- and poorly drained valley ecosystems in the highlands of East Africa.

Zoom in at African country level: Potential climate-induced changes in areas of suitability for survival of malaria vectors[13]

Predicting *Anopheles sp.* vector population densities and boundary shifts is crucial in preparing for malaria risks and unanticipated outbreaks. Although shifts in the distribution and boundaries of the major malaria vectors (*A. gambiae* sub-species and *A. arabiensis*) across **Africa** have been predicted, quantified areas of absolute change in zone of suitability for their survival have not been defined. This study quantifies areas of absolute change conducive for the establishment and survival of these vectors, per African country, under two climate change scenarios. Conclusions indicate that the potential shifts of malaria vectors have implications for human exposure to malaria, as recrudescence of the disease is likely to be recorded in several new areas and regions. Therefore, it remains crucial to develop, compile and share malaria preventive measures, which can be adapted to different scenarios.

Impact of climate change on global malaria distribution[14]

This study is the first multi-malaria model comparison exercise. It was conducted to estimate the impact of future climate change and population scenarios on malaria transmission at a global scale and to provide recommendations for the future. Results indicate that future climate might become more suitable for malaria transmission in the tropical highland regions. However, other important socioeconomic factors such as land use change, population growth and urbanization, migration changes, and economic development will need to be factored into future risk assessments.

Climate and epidemiology of malaria in Port Harcourt Region, Nigeria[15]

The study examines the effect of climate on the occurrence of malaria by matching data from the national meteorological service and hospital records. It concludes that the prevalence of malaria is significantly dependent on the increase in rainfall and temperature and recommends regular clearing of drains and the surrounding environment combined with routine malaria control activities.

13 Zoom in at African country level: Potential climate-induced changes in areas of suitability for survival of malaria vectors. (http://www.ij-healthgeographics.com/content/pdf/1476-072X-13-12.pdf).

14 Impact of climate change on global malaria distribution. http://www.pnas.org/content/111/9/3286.full.pdf).

15 Climate & epidemiology of malaria in Port Harcourt Region, Nigeria. American Journal of Climate Change. 2015; 4: 40–47.