MALARIA & VECTOR-BORNE

ESTIMATES GLOBAL CLIMATE IMPACT

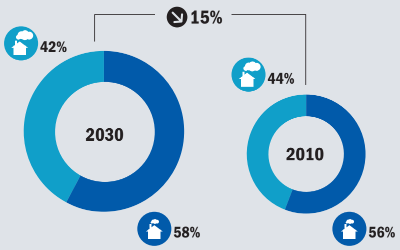
2010 EFFECT TODAY

DEATHS PER YEAR **20,000**

2030 EFFECT TOMORROW

DEATHS PER YEAR **20,000**

MORTALITY IMPACT



CONFIDENCE
INDICATIVE

SEVERITY
AFFECTED
INJUSTICE
PRIORITY
MDG EFFECT

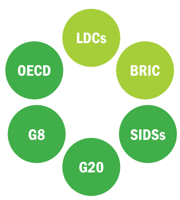
- Malaria is a large-scale cause of illness, with over 90% of deaths occurring among children in tropical regions, in particular in Africa and the Pacific
- Malaria and other vector-borne diseases have declined over the last decade, as a result of poverty reduction and anti-malaria programmes
- Vector-borne diseases are sensitive to climate; as climate becomes warmer and wetter, changes to their prevalence will slow and complicate efforts aimed at eradication
- Fighting vector-borne diseases is highly cost effective; minimizing vulnerability requires action to reduce or eradicate prevalence and increase the resilience of populations affected

RELATIVE IMPACT

HOTSPOTS

2010		2030
6,000	DR CONGO	5,750
1,750	MOZAMBIQUE	1,750
1,750	TANZANIA	1,750
1,500	UGANDA	1,500
2,250	NIGERIA	1,250

GEOPOLITICAL VULNERABILITY



Deaths
Developing Country Low Emitters
Developing Country High Emitters
Developed
Other Industrialized
= Deaths per 10 million
Change in relation to overall global population and/or GDP

A major cause of illness in developing countries, climate change will worsen the burden of vector-borne diseases, although it is difficult to predict with any precision the areas that will be worst affected (IPCC, 2007). Countries that already have serious malaria burdens should expect to see an aggravation of these diseases, due to increasing temperatures and other climate-related phenomena. Such aggravations will be offset to some degree through anticipated socio-economic development in the predominantly lower-income countries in which these diseases are most prevalent (Mathers and Loncar, 2005). But vector-borne outbreaks are also re-occurring in places where they have long been absent: a yellow fever epidemic in Uganda in 2010 was the first in 20 years (Rosenberg and Beard, 2011). As climate change brings warmer weather to colder places, the range of vector-borne disease is also shifting from the tropics, and to higher altitudes, as insects and other vectors roam further afield. In the US for instance, Leishmaniasis, a vector-borne disease originating in Mexico and Texas has begun to shift further north (González et al., 2010). Communities now linked by globalization are also becoming exposed to higher risks, as illustrated for instance by a colony of yellow fever mosquitoes recently found in Holland (Enserink, 2010). Successful international programmes fighting these diseases should be reinforced in areas of particular risk, in order to safeguard against set-backs due to climate change in the fight to eradicate malaria and control other deadly vector-borne diseases (WHO and RBMP, 2010).

CLIMATE MECHANISM

Climate change is understood to enable the shift in vector-borne diseases like malaria, dengue, and yellow fever in several ways. As mountainous areas warm up for instance, vectors, such as mosquitos, would reach higher altitudes and increase exposure to disease in zones adjacent to affected areas; the same can be said of higher latitudes at the boundaries of current areas of infection. Transmission conditions and seasons are likely to expand in warm areas where rainfall used to be too low to support vectors, but now will increase. Temperature changes affect incubation rates and, together with range changes, increase the amount of time people are exposed to insect bites (Jetten and Focks, 1997). However, transmission could also decline, due either to a drop in rainfall and temperature peaks—beyond which diseases like malaria cannot thrive—or due to very high rainfall that washes away insect larvae (WHO, 2004 and 2011). At a smaller scale, temperatures also influence the survival rates of mosquitoes (Martens et al., 1999). As was pointed out in the Ghana country study in this report, climate change also affects human behaviour, as, for instance, when people sleep outside on the hottest nights without mosquito net protection, significantly increasing their risk of contracting vector-borne diseases.

IMPACTS

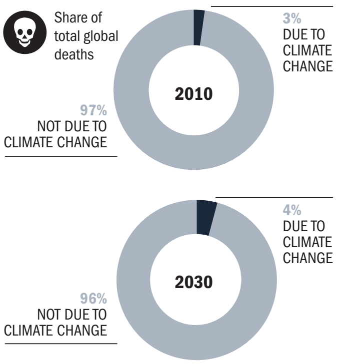
The impact of climate change on the key vector-borne diseases of malaria, dengue fever and yellow fever is estimated to be over 20,000 deaths a year today, with 6 million people affected.

Fourteen African and Pacific island countries are estimated to suffer Acute and Severe levels of vulnerability to the effects of climate change on vector-borne disease; most of these countries are land-locked developing countries, such as the Central African Republic or Zambia, or small island developing states, such as the Solomon Islands. The greatest total effects are estimated to occur in the DR Congo, with nearly 6,000 additional deaths due to vector-borne diseases in 2010. Five other countries also suffer large scale effects in the thousands: Nigeria, Mozambique, Tanzania, Uganda, and Côte d'Ivoire. By 2030, the effect of climate change on malaria is expected not to change since it is expected that there will be continued large-scale reductions in the prevalence of malaria, due mainly to economic growth over this 20-year period. In fact, as a proportion of population, malaria is estimated to decrease as a concern under these assumptions.

THE BROADER CONTEXT

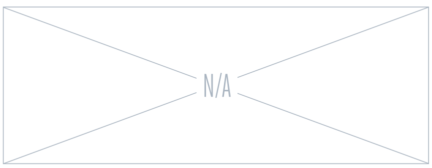
According to the World Health Organization, malaria has undergone a major reduction in its overall prevalence in the last decade, falling from 1.2 million deaths in 2000 to 0.8 million deaths in 2008. However, most of the reduction occurred in the first years of the decade: over the four-year period between 2004 and 2008, there was a reduction of only 60,000 deaths (WHO BDD, 2000 and 2011). However, even at lowered rates of death, malaria

BIGGER PICTURE

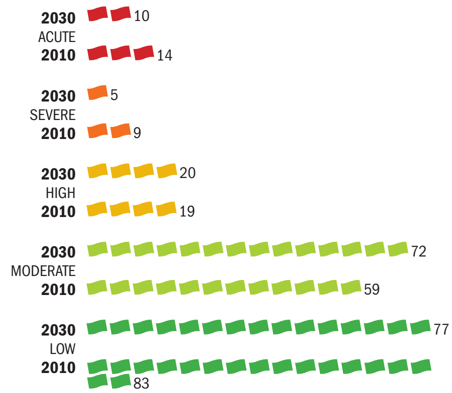


SURGE

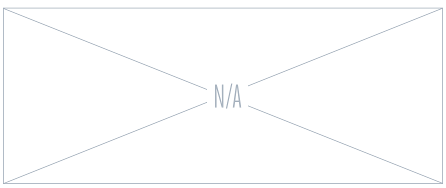
OCCURRENCE



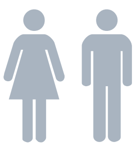
VULNERABILITY SHIFT



PEAK IMPACT



GENDER BIAS



INDICATOR INFORMATION

MODEL: McMichael et al., 2004

EMISSION SCENARIO: S750 (IPCC, 2007)

BASE DATA: WHO BDD, 2011

= 5 countries (rounded)

Acute Severe High Moderate Low

is considered one of the largest global contributors to sickness. Interpretations of the scale of the disease also vary dramatically, with some estimating more than 5 billion clinical episodes that resemble, and could be characterized as, malaria occurring in endemic areas annually (DCPP, 2006). Other factors, such as economic growth, will likely compensate for increased risks due to climate change, but they will also slow efforts to eradicate these diseases (Reiter, 2001).

Given that climate-aggravated malaria is highly prevalent in impoverished rural communities, delaying efforts to eradicate the disease will also delay development progress. As people in the affected communities also have a high propensity to migrate, malaria could also be carried to new areas, generating epidemics (Haleset al., 2000).

VULNERABILITIES AND WIDER OUTCOMES

Experts have identified various determinants of malaria and vector-borne diseases. Environmental conditions play an important role, such as high temperatures, high rainfall, and humidity, together with pools of still, sun-drenched water (WHO, 2009). Social vulnerabilities include the level of education enabling people to take preventative measures, such as draining mosquito ponds, or address environmental predispositions to disease (Garg et al., 2009). Finally, poverty seriously inhibits access to medicine, vaccines, and preventative measures, such as insecticides and bed nets (Breman, 2001).
Given that some 6 million people are affected, the economic productivity of those worst hit communities is jeopardized. For example, when members of rural, subsistence families lose working hours because of illness, their already minimal disposable income will be threatened further. The Ghana country study in this report illustrated how in malaria-infested areas, people were often ill several times in a given year. One study has showed how a 10% reduction in malaria is associated with a 0.3% increase in economic growth (Gallup and Sachs, 2001). With over 90% of the death toll assessed here affecting children under 15, a greater challenge faces those making efforts to improve child health, such as through attainment of Millennium Development Goal 4 for reducing child mortality.

RESPONSES

Responses are numerous and comprise preventative and treatment-type actions. Drugs and vaccines through national or region-specific immunization programmes (for dengue and yellow fever, not malaria), insecticide-treated bed nets, use of pesticides outdoors, insecticide for personal use and indoors, and civil engineering projects to drain malaria breeding sites are all key components of the anti-malaria and vector-borne response toolkit. Access to affordable health services, including through low-cost health insurance, is also critical for the speedy diagnosis and treatment of disease. Education and awareness can also help to raise the level of preventative responses and encourage health services to be sought soon after the onset of symptoms. Aside from civil infrastructure projects, vector-borne disease control is considered to be highly cost effective (DCPP, 2006).

THE INDICATOR

The indicator measures the effect of climate change on malaria, dengue fever, and yellow fever, based on World Health Organization research and data (WHO, 2004; WHO BDD, 2011). The climate change effect on malaria is used as a proxy for dengue and yellow fever, since research suggests similar mechanics apply (Epstein, 2001; Hales et al., 2002). Uncertainties in climate parameters, particularly rainfall, environmental, and socio-economic factors call into question the reliability of all estimations. The indicator is also conservative from the perspective that it does not take into account a variety of other vector-borne diseases, whose prevalence may also be significantly influenced by climate change, such as viral encephalitis, schistosomiasis, leishmaniasis, Lyme disease, and onchocerciasis (WHO, 2003).

ESTIMATES COUNTRY-LEVEL IMPACT

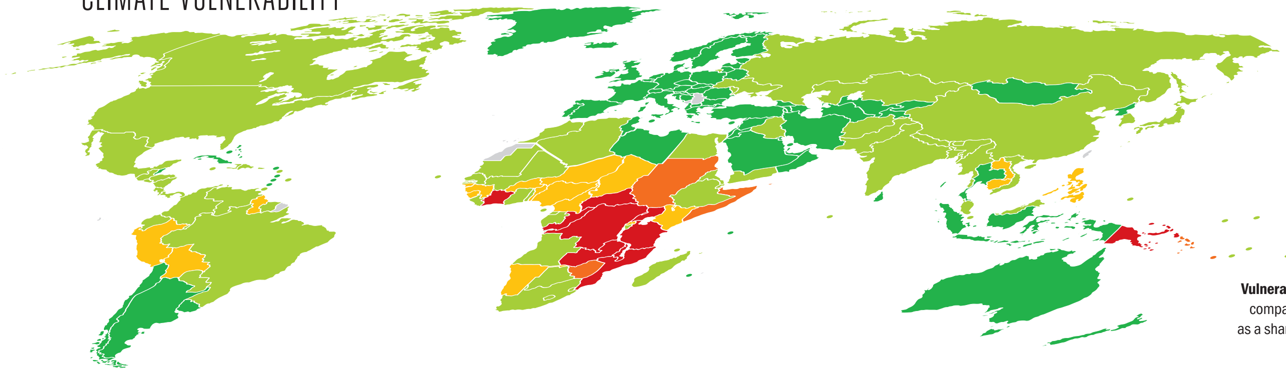
COUNTRY	2010	2030	2010	2030
ACUTE				
Central African Republic	400	400	100,000	100,000
Congo	200	200	55,000	55,000
Cote d'Ivoire	1,250	1,250	300,000	300,000
DR Congo	6,000	5,750	1,500,000	1,500,000
Malawi	600	600	150,000	150,000
Mozambique	1,750	1,750	500,000	450,000
Papua New Guinea	400	850	100,000	250,000
Tanzania	1,750	1,750	450,000	450,000
Uganda	1,500	1,500	400,000	400,000
Zambia	600	600	150,000	150,000
SEVERE				
Solomon Islands	20	15	5,250	4,500
Somalia	200	200	50,000	60,000
Sudan/South Sudan	750	950	200,000	300,000
Vanuatu	1	5	1,250	2,500
Zimbabwe	250	250	65,000	60,000
HIGH				
Benin	95	60	25,000	20,000
Bolivia	60	150	35,000	70,000
Burkina Faso	350	200	90,000	50,000
Burundi	150	150	40,000	40,000
Cambodia	90	90	25,000	30,000
Cameroon	250	150	65,000	40,000
Chad	250	150	65,000	35,000
Guinea	200	100	50,000	35,000
Guinea-Bissau	30	20	8,500	4,750
Guyana	1	5	800	1,250
Kenya	250	250	65,000	70,000
Kiribati	1	1	150	350
Laos	40	50	15,000	20,000
Namibia	30	30	10,000	10,000

COUNTRY	2010	2030	2010	2030
Niger	250	150	70,000	40,000
Nigeria	2,250	1,250	600,000	400,000
Peru	100	200	60,000	100,000
Philippines	450	900	250,000	500,000
Rwanda	70	65	20,000	20,000
Sierra Leone	150	75	35,000	20,000
MODERATE				
Afghanistan	10	15	2,750	6,000
Algeria			5	5
Angola	150	90	65,000	35,000
Bangladesh		45		15,000
Barbados			5	15
Bhutan				100
Botswana	1	1	400	400
Brazil	100	250	55,000	100,000
Canada			100	150
Cape Verde			5	1
China	50	80	25,000	45,000
Colombia	45	100	25,000	55,000
Comoros	5	1	1,000	550
Costa Rica			20	55
Djibouti	1	1	350	400
Dominica			10	15
Dominican Republic	10	20	5,250	10,000
Ecuador	10	20	5,500	10,000
Egypt	10	10	4,250	5,000
El Salvador	1	5	900	2,000
Equatorial Guinea	5	5	2,750	1,500
Eritrea	1	1	450	450
Ethiopia	400	400	100,000	100,000
Fiji	1	1	350	550
Gabon	5	5	2,250	1,500

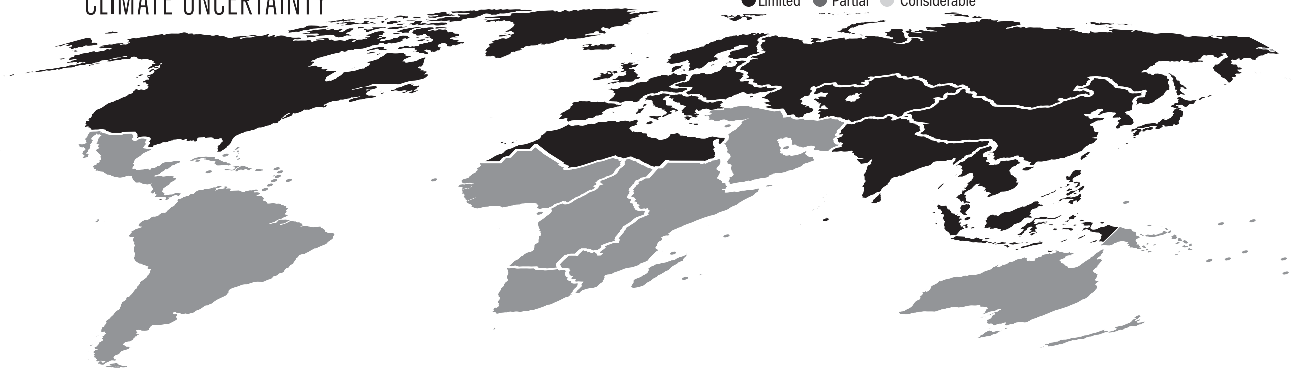
COUNTRY	2010	2030	2010	2030
Gambia	15	10	4,000	2,250
Ghana	100	65	30,000	20,000
Guatemala	1	5	800	1,750
Haiti	35	45	10,000	20,000
Honduras	5	10	2,500	6,000
India		300		95,000
Iraq			5	15
Jamaica			5	5
Japan			100	150
Kazakhstan			80	150
Lesotho			25	35
Liberia	40	25	10,000	6,750
Madagascar	15	10	4,250	2,250
Malaysia	30	50	10,000	20,000
Maldives				75
Mali	150	90	45,000	25,000
Marshall Islands			65	150
Mauritania	10	5	3,000	1,750
Mexico	1	5	700	1,500
Micronesia			45	95
Moldova			35	65
Morocco			1	5
Myanmar		85		25,000
Nepal		1		450
Nicaragua	1	5	800	1,750
Pakistan	100	400	40,000	100,000
Palau			5	10
Panama			1	1
Paraguay			1	5
Russia	1	1	300	450
Samoa		1	150	300
Sao Tome and Principe			40	20

Additional mortality due to climate change - yearly average

CLIMATE VULNERABILITY



CLIMATE UNCERTAINTY



COUNTRY	2010 (deaths)	2030 (deaths)	2010 (persons affected)	2030 (persons affected)
Senegal	100	65	30,000	20,000
Singapore	1	1	250	300
South Africa	5	5	2,000	2,000
South Korea	1	1	350	600
Suriname	1	1	500	1,000
Swaziland			75	75
Togo	40	25	10,000	6,250
Tonga		1	85	200
Trinidad and Tobago			20	40
Tuvalu			5	5
Ukraine	1	1	200	300
United States	1	1	600	1,000
Venezuela	15	30	5,250	15,000
Vietnam	40	55	15,000	25,000
Yemen	80	95	20,000	25,000
LOW				
Albania				
Antigua and Barbuda				
Argentina				
Armenia				
Australia				
Austria				
Azerbaijan				
Bahamas				
Bahrain				
Belarus				
Belgium				
Belize				
Bosnia and Herzegovina				
Brunei				
Bulgaria				
Chile				

COUNTRY	2010 (deaths)	2030 (deaths)	2010 (persons affected)	2030 (persons affected)
Croatia				
Cuba				
Cyprus				
Czech Republic				
Denmark				
Estonia				
Finland				
France				
Georgia				
Germany				
Greece				
Grenada				
Hungary				
Iceland				
Indonesia				
Iran				
Ireland				
Israel				
Italy				
Jordan				
Kuwait				
Kyrgyzstan				
Latvia				
Lebanon				
Libya				
Lithuania				
Luxembourg				
Macedonia				
Malta				
Mauritius				
Mongolia				
Netherlands				

COUNTRY	2010 (deaths)	2030 (deaths)	2010 (persons affected)	2030 (persons affected)
New Zealand				
North Korea				
Norway				
Oman				
Poland				
Portugal				
Qatar				
Romania				
Saint Lucia				
Saint Vincent				
Saudi Arabia				
Seychelles				
Slovakia				
Slovenia				
Spain				
Sri Lanka				
Sweden				
Switzerland				
Syria				
Tajikistan				
Thailand				
Timor-Leste				
Tunisia				
Turkey				
Turkmenistan				
United Arab Emirates				
United Kingdom				
Uruguay				
Uzbekistan				

Additional persons affected due to climate change - yearly average