Malaria Risk and Forest Cover Change in Kenya: A Geospatial Analysis

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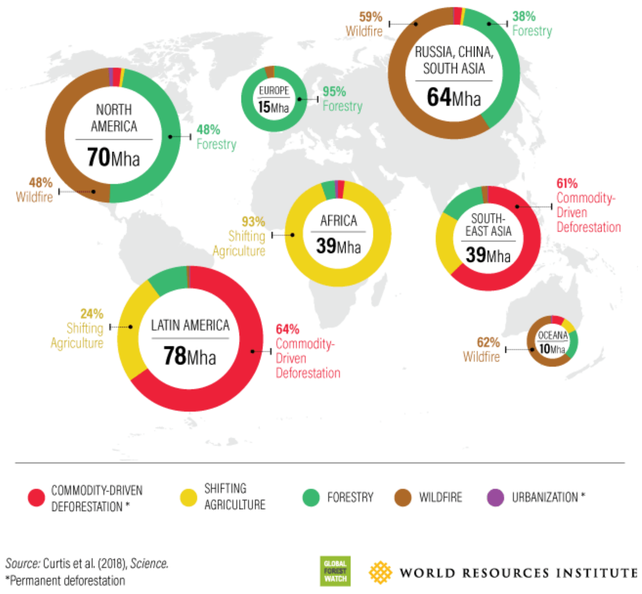
BACKGROUND

The relationship between **forest cover loss** and **infectious disease risk** is **poorly understood** and **needs further investigation**, particularly in sub-Saharan Africa, and with regards to the effect to **vulnerable populations**—namely, children. The proposed research examines **ecological determinants of malarial disease** by investigating the linkage between forest cover change and in Kenya using a total population incidence indicator, and a pediatric prevalence indicator.

AIMS AND OBJECTIVES

1. **Understanding the evidence basis** for forest cover change factors underlying malaria risk in sub-Saharan Africa
    1. What amount of forest cover change is most associated with malaria risk changes?
    2. How do these factors affect pediatric malaria risk?
2. **Analyze mechanistic factors** leading to altered risk
    1. What are the most significant mechanisms resulting in increased malaria risk?
    2. How does this analysis inform our current theoretical understanding of the relationship between forest cover change and malaria risk?

Regional Tree Cover Loss by Driver for the Period 2001–2015



Source: Curtis et al. (2018), *Science*.
*Permanent deforestation

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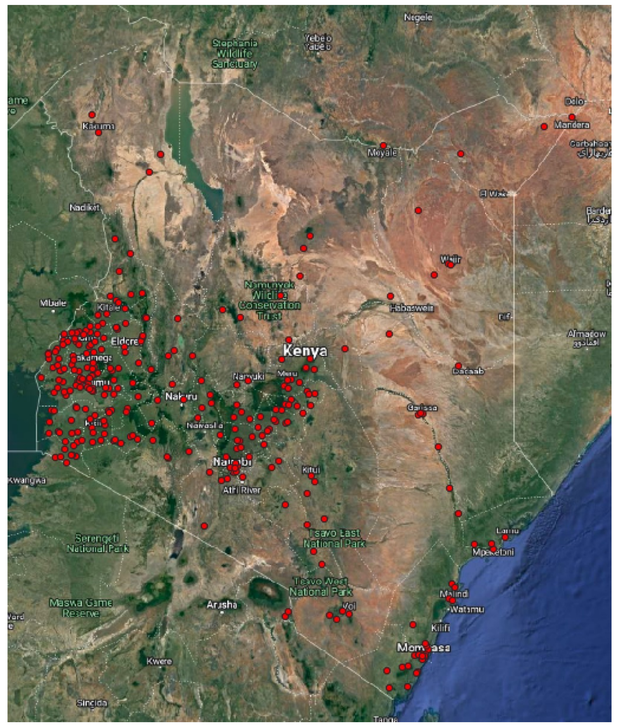
P. G. Curtis, et al. Classifying drivers of global forest loss. *Science*. 361, 1108-1111 (2018).



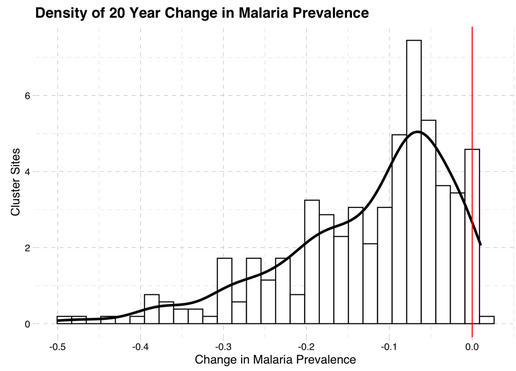
METHODOLOGY

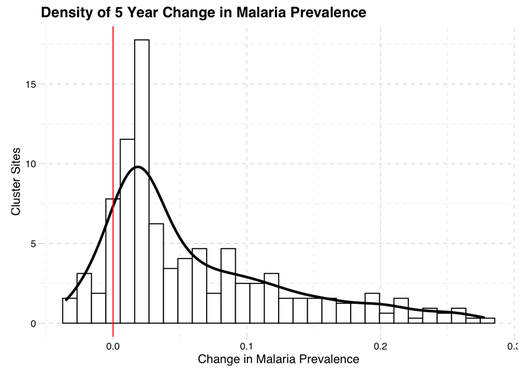
We propose regression analyses to investigate forest cover data and malaria incidence and pediatric (aged 2–10 years) prevalence data from selected **US Agency for International Development's Demographic and Health Survey (DHS)** datasets to assess the association between malaria disease and forest cover change. The research will use DHS-derived cluster sites along the human–wildlife interface in Kenya as geographical variables. To measure forest cover change, **Enhanced Vegetation Index** will be used as an indicator. **Malaria incidence** and **pediatric prevalence by cluster site** is quantified in the DHS dataset. We plan to run regression analyses plotting forest cover change versus malaria incidence and pediatric prevalence at the cluster level at **5-year time points from 2000 to 2020.**

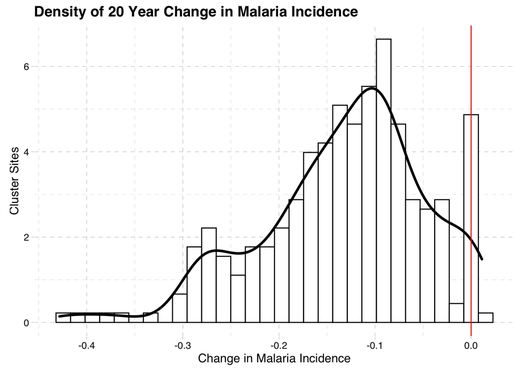
INITIAL INTERPRETATIONS

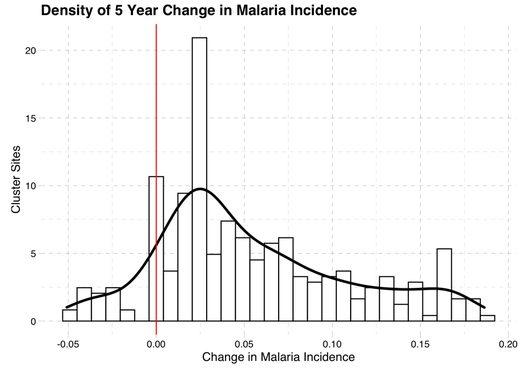
1. **20 year** change in malaria rates show **decreasing** trend; **5 year** change show **increasing** trend
2. **Insecticide treated bed nets (ITN)** and metrological conditions potentially stronger at predicting association with malaria
3. **More data points needed** – annual data for Kenya and/or using cluster sites available throughout sub-Saharan Africa as available via DHS

PRELIMINARY RESULTS









20-year Predict Difference

	Estimate	t value	Pr(>|t|)
(Intercept)	2.67e-01	4.70	4.10e-06
Aridity_2020	-1.55e-02	-5.31	2.00e-07
Enhanced_Vegetation_Index_2020	-3.54e-01	-6.18	0.00e+00
ITN_Coverage_2020	-3.65e-01	-4.51	9.80e-06
Wet_Days_2020	1.57e-02	3.10	2.12e-03
Change_Enhanced_Vegetation_Index_20_Year	5.16e-01	3.52	5.12e-04
Change_Aridity_20_Year	7.05e-02	10.70	0.00e+00
Change_Rainfall_20_Year	-8.22e-05	-3.58	4.07e-04
Change_Wet_Days_20_Year	-1.73e-01	-9.74	0.00e+00
Change_Aridity_15_Year	-3.51e-02	-8.19	0.00e+00
Change_Wet_Days_15_Year	1.25e-01	8.33	0.00e+00
Change_Aridity_10_Year	5.76e-03	2.60	9.77e-03
Change_ITN_Coverage_10_Year	2.52e-01	3.67	2.93e-04
Change_Wet_Days_10_Year	-7.15e-02	-7.43	0.00e+00
Change_Enhanced_Vegetation_Index_5_Year	-8.72e-01	-4.57	7.50e-06
Change_Aridity_5_Year	-7.56e-03	-4.12	5.07e-05
Change_Rainfall_5_Year	1.73e-04	5.54	1.00e-07

R-squared = 0.781 | Adj. R-squared = 0.768 F-statistic = 61.924 | p-value = 9.77e-82

5-year Predict Difference

	Estimate	t value	Pr(>|t|)
(Intercept)	-7.99e-02	-7.37	0.00e+00
Aridity_2020	4.15e-03	4.32	2.16e-05
Rainfall_2020	-4.98e-05	-4.40	1.57e-05
Wet_Days_2020	1.20e-02	6.37	0.00e+00
Change_Aridity_20_Year	-2.14e-02	-8.28	0.00e+00
Change_Rainfall_20_Year	1.17e-04	8.78	0.00e+00
Change_Wet_Days_20_Year	5.10e-02	6.94	0.00e+00
Change_Enhanced_Vegetation_Index_15_Year	2.24e-01	5.04	8.00e-07
Change_Aridity_15_Year	7.69e-03	4.07	6.19e-05
Change_Rainfall_15_Year	7.64e-05	3.70	2.60e-04
Change_Wet_Days_15_Year	-4.63e-02	-6.98	0.00e+00
Change_ITN_Coverage_10_Year	1.82e-01	8.59	0.00e+00
Change_Rainfall_10_Year	-8.89e-05	-5.26	3.00e-07
Change_Wet_Days_10_Year	-2.68e-02	-9.41	0.00e+00
Change_ITN_Coverage_5_Year	-1.36e-01	-9.17	0.00e+00
Change_Rainfall_5_Year	-6.33e-05	-6.27	0.00e+00

R-squared = 0.912 | Adj. R-squared = 0.908 F-statistic = 193.52 | p-value = 1.06e-137

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