Supplementary Information (SI) 1: Predictors of age-standardised *Plasmodium falciparum* parasite rate (*PfPR*$_{2-10}$)

**SI 1.1 Urbanisation:** A surface of urbanisation in Somalia derived from a 100×100 m spatial resolution population surface developed from a combination of census, satellite imagery and land cover data$^{1,2}$ was used to define each survey location as urban or rural. Somalia population map was derived by a combination of simple and semi-automated processes involving the re-distribution of district level population estimates to a finer spatial scale using land cover and land use datasets$^{1}$. A refined land cover map was prepared by combining the settlement data with Africover data$^{3}$ and other ancillary GIS data on roads, rivers from Vector Map Level Zero (VMAP 0)$^{4}$ and the Landsat satellite imagery. A total of 22 land cover classes were formed and population density within these classes was calculated with urban and rural extents derived from the GEOterrain consultancy$^{5}$. These calculated densities were then used as weightings to redistribute population by settlement and in land cover types that were unaccounted for by existing settlement size data (Figure SI 1A).

**SI 1.2 Enhanced vegetation Index (EVI):** EVI is an index of intensity of photosynthetic activity and a good proxy for rainfall ranges from 0 (no vegetation) to 1 (complete vegetation). Monthly EVI surfaces at 1×1 km spatial resolution derived from the global Moderate Resolution Imaging Spectro-radiometer (MODIS) satellite imagery for the period 2001-2010 were downloaded from the MODIS website$^{6}$ and were used to compute annual mean EVI. These monthly maps were used to compute annual mean EVI for the years 2007 to 2010 (Figure SI 1B).

**SI1.3 Precipitation:** Monthly mean precipitation (mm) raster surfaces at 1×1 km resolution were downloaded from the WorldClim website$^{7}$ and used as a proxy for rainfall. The Worldclim database was compiled using weather stations data collected world-wide for the period 1950-2000 and interpolated using spline methods$^{8}$. The monthly mean precipitation was used to compute annual mean precipitation surfaces for the years 2007 to 2010 (Figure SI 1C).

**SI1.4 Temperature suitability Index (TSI):** As metric for the effect of temperature on malaria transmission, TSI at a spatial resolution of 1×1 km$^9$ was used. TSI was constructed using monthly temperature time series$^{7}$ within a biological modelling framework to quantify the effect of ambient temperature on sporogony and vector survivorship and determine the suitability of an area to support transmission globally$^9$. On a scale of increasing transmission suitability, TSI ranges from 0 (unsuitable) to 1 (most suitable) (Figure SI 1.1.1D).
SI 1.5 Potential mosquito breeding sites: To define potential breeding sites the Global Lakes and Wetlands databases (GLWD) developed as a partnership between the World Wildlife Fund and the Center for Environmental Systems Research, University of Kassel, Germany10 was used. The GLWD data contained 12 wetland classifications but for Somalia the following wetland classes were retained for analysis: lake, rivers, floodplains, reservoirs and coastal wetlands. Intermittent water bodies and brackish and saline water were removed. Euclidean distances to these wetlands were computed in ArcGIS 10 (ESRI Inc. NY, USA) (Figure SI 1E).

SI 1.6 Statistical analysis of the predictors of PfPR<sub>2-10</sub>

The values of the underlying ecological, climatic and population covariates describe above were extracted to each survey location using ArcGIS 10 Spatial Analyst tool. Distance to potential breeding sites was log-transformed before analysis because of its high positive skew. The covariates were then included in total-sets analysis which is an automatic model selection process based on a generalized linear regression model and implemented using the bestglm package in R<sup>11,12</sup>. This approach selects the best combination of the covariates based on the value of the Bayesian Information Criteria (BIC) statistic<sup>13</sup> which selects the lowest BIC as the best model fit. The model excluding TSI showed the lowest BIC and therefore the best fit (Table SI 1.1.1).

Table SI 1.1.1 Summary of regression analysis of covariates

<table>
<thead>
<tr>
<th>Covariate</th>
<th>Odds Ratio (95% CI)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urbanisation</td>
<td>-0.88 (-1.02- -0.69)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>EVI</td>
<td>0.81 (0.19-1.44)</td>
<td>0.011</td>
</tr>
<tr>
<td>Precipitation</td>
<td>0.003 (0.002-0.004)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>TSI</td>
<td>-0.68 (-0.89 - 0.01)</td>
<td>&lt;0.312</td>
</tr>
<tr>
<td>Log of distance to wetlands</td>
<td>0.27 (0.24 – 0.31)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
Figure SI 1 Somalia maps of 1×1 km spatial resolution of: A) population distribution showing the location of urban centres (in red); B) annual mean enhanced vegetation index (EVI); C) annual mean precipitation (mm); D) temperature suitability index for *Plasmodium falciparum* transmission; E) distance (km) to nearest water body.
References


5. GeoTerraImage. [www.geoterraimage.com. Accessed 15 February 2012.](http://www.geoterraimage.com)


