Appendix S1 – Reflexivity Statement

1. How does this study address local research and policy priorities?

Malaria is a leading cause of illness and death in Uganda. The country has made considerable efforts to control malaria burden through repeated distributions of insecticide treated nets and indoor residual spraying campaigns. Nevertheless, the burden of malaria remains high and progress to reduce its impact has slowed. Therefore, Uganda is a setting that would benefit substantially from high resolution, timely maps of malaria burden. These maps indicate areas that could be targeted for future interventions. They also allow for retrospective evaluation of the impact of interventions. The conclusions from this analysis indicate that these maps can continue to be generated with little financial investment from the National Malaria Control Programme. Furthermore, this study is of interest to other high burden malaria endemic countries that seek to improve the targeting of their control interventions.

2. How were local researchers involved in study design?

Local researchers were involved extensively in data collection, the design of the study, and interpretation/dissemination of findings. JFN led collection of the health facility data. EVK and IN managed the data and helped with cleaning, mapping, and data analysis. MRK helped to secure funding for the analysis, provided oversight of the data collection procedures, and helped with interpretation of findings.

3. How has funding been used to support the local research team?

Local researchers are supported through the International Centers of Excellence in Malaria Research (ICMER) program (U19AI089674). This funding stream also supports all research activities under the Uganda Malaria Surveillance Programme.

4. How are research staff who conducted data collection acknowledged?

Staff extensively involved in data collection and management (JFN, EVK, IN) are included as authors on the manuscript. Staff with less involvement in the day-to-day operations of the research are acknowledged at the end of the manuscript.

5. Do all members of the research partnership have access to study data?

All members of the partnership have access to all study data.

6. How was data used to develop analytical skills within the partnership?

AE, the lead author on the paper, led workshops on geo-spatial data analysis for partners.

7. How have research partners collaborated in interpreting study data?

Partners were kept abreast of research findings periodically throughout the analysis stages through presentations in regular meetings. During these meetings, partners provided feedback and insights into interpretation of results. These insights were incorporated into the manuscript.

8. How were research partners supported to develop writing skills?

Although there was no specific plan in place to refine writing skills for the purpose of this analysis, partners made extensive edits at each iteration of the manuscript.

9. How will research products be shared to address local needs?

The Infectious Diseases Research Collaboration (IDRC), the Ugandan partner included in this work, holds annual dissemination meetings where research findings are presented to the Ministry of Health and other key stakeholders such as the President's Malaria Initiative/CDC. Regular, less formal meetings are also held regularly between IDRC and the Ugandan National Malaria Control Programme. The findings from this work will be presented at these meetings.

10. How is the leadership, contribution and ownership of this work by LMIC researchers recognised within the authorship?

Four co-authors, including the second author, are LMIC researchers. These researchers participated extensively in the data collection, management, cleaning, analysis, and interpretation. Other LMIC researchers less involved in the day-to-day of this project are acknowledged at the end of the manuscript.

11. How have early career researchers across the partnership been included within the authorship team?

Several early career researchers are included (AE, JFN, IN, EVK) and took leadership roles on data collection and analysis. The lead author on this paper was a PhD student at the time of the analysis/writing.

12. How has gender balance been addressed within the authorship?

Three authors are female (including the lead author, AE), and seven authors are male.

13. How has the project contributed to training of LMIC researchers?

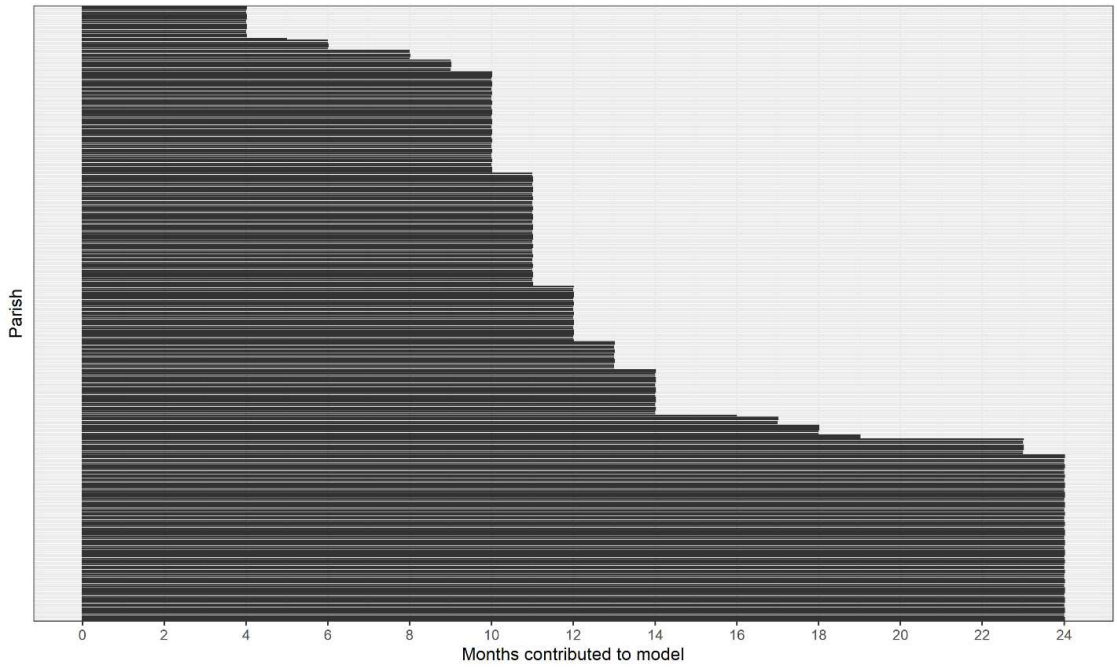
While not primarily a capacity building project, this project allowed JFN, EVK, and IN training in working with spatial data. Furthermore, LMIC researchers were actively involved in leading the data collection, storage, and management, and in the interpretation of findings.

14. How has the project contributed to improvements in local infrastructure?

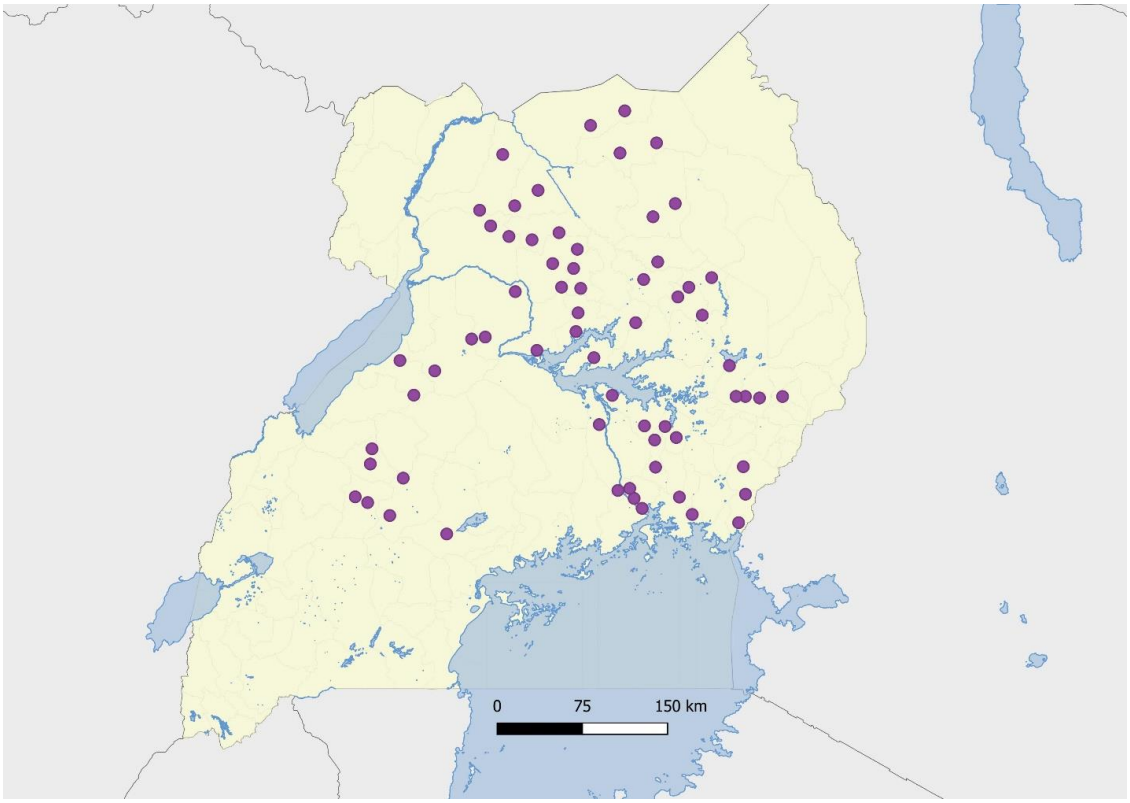
The Uganda Malaria Surveillance Programme provides all sentinel sites with a laptop to electronically input outpatient data. These health facilities have benefited greatly from this, as the monthly reports they generate for the Ugandan Ministry of Health are now automated.

15. What safeguarding procedures were used to protect local study participants and researchers?
The data collected and subsequently used in the study was de-identified.

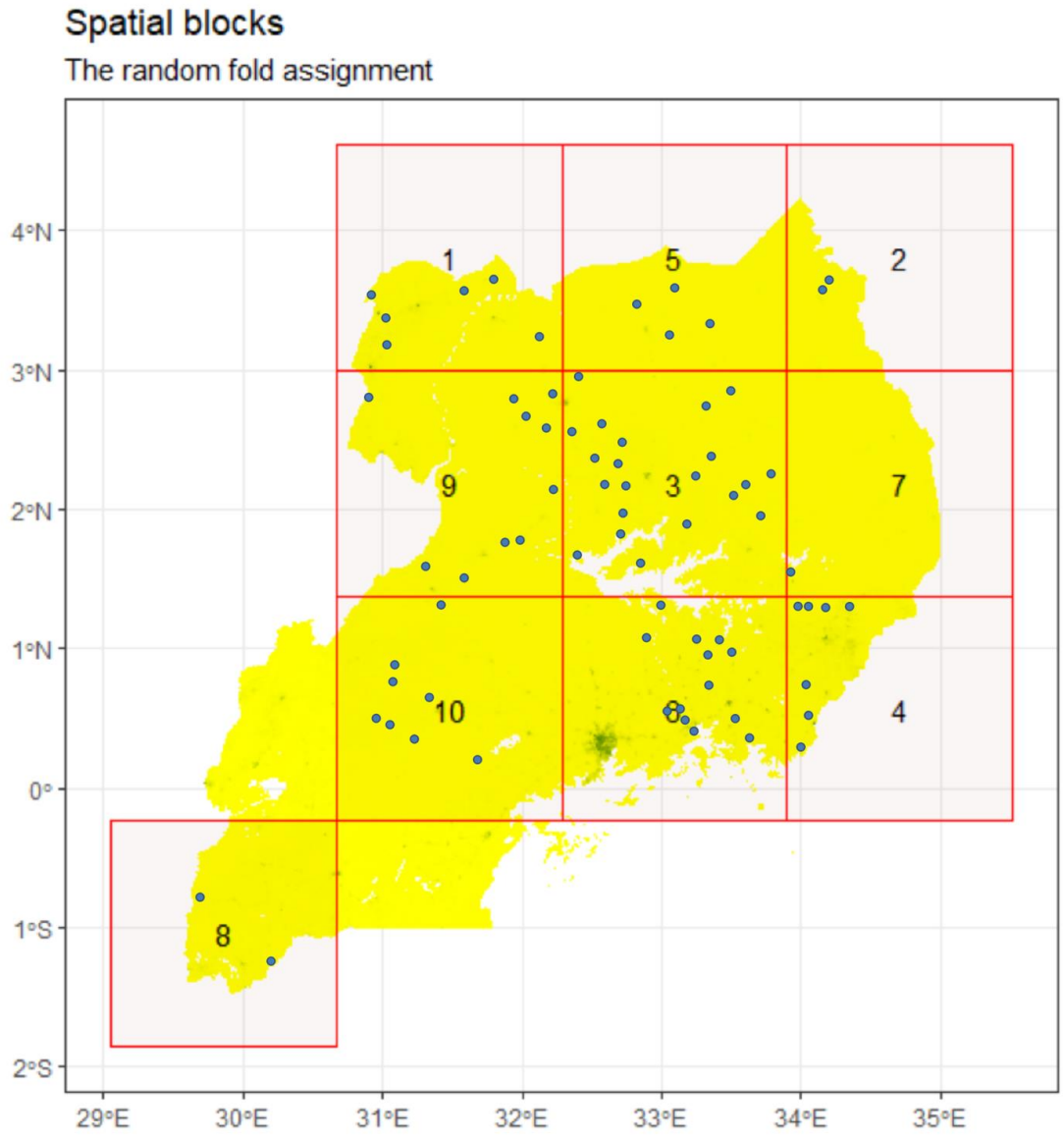
Supplemental Figure 1: Number of months each parish contributed to the final dataset



Supplemental Figure 2: Map of 64 high density health facilities



Supplemental Figure 3: Map of spatial blocks of 200km for cross validation and location of Malaria Reference Centers



Supplemental Table 1. Descriptive information on Malaria Reference Centers included in spatio-temporal model.

District	Site	Number of months of data observed	Number of parishes included in catchment area	Population of catchment area	Number of laboratory confirmed cases of malaria	Malaria incidence (per 1000)
Agago	Lira-Kato	13	3	1869	9594	4738
Agago	Patongo	24	3	7092	13476	950
Alebtong	Alebtong	23	6	8777	2001	119
Amolatar	Amolatar	24	7	12630	1892	75
Amuria	Asamuk	12	7	7727	7479	968
Amuria	Morungatuny	11	5	6860	4518	718
Amuru	Amuru	14	4	36831	2456	57
Amuru	Atiak	18	6	17474	15896	606
Apac	Aduku	24	5	16957	14240	420
Apac	Akokoro	10	2	1214	2597	2567
Apac	Teboke	11	5	20695	4837	255
Arua	Cilio	13	4	8390	3172	349
Arua	Opia	24	3	3615	14862	2056
Bukedea	Bukedea	4	4	1046	469	1345
Bukedea	Kolir	14	3	3530	2798	679
Busia	Busitema	10	4	10820	4650	516
Busia	Lumino	24	5	6058	12003	991
Buyende	Bugaya	11	4	4289	5780	1470
Buyende	Kidera	8	4	22835	5583	367
Dokolo	Dokolo	14	5	13874	5395	333
Gomba	Maddu	11	4	8184	865	115
Gulu	Awach	24	6	30035	24279	404
Gulu	Pabwo	10	2	5465	4247	933
Hoima	Butema	11	7	16330	947	63
Hoima	Kigorobya	24	8	23707	8857	187
Jinja	Budondo	11	3	4738	1729	398
Jinja	Butagaya	12	2	2887	1658	574
Jinja	Walukuba	12	2	3276	1314	401
Kaabong	Kalapata	11	5	4961	5681	1249
Kaabong	Lokolia	19	2	1027	3887	2390
Kaliro	Bumanya	10	5	16691	2678	193
Kaliro	Nawaikoke	10	4	2393	2728	1368
Kanungu	Kihihi	24	8	8180	5833	357
Kapchorwa	Kaserem	12	5	2250	146	65
Kapelebyong	Kapelebyong	14	1	4356	3445	678
Kapelebyong	Obalanga	12	7	18863	7990	424
Kayunga	Bbaale	24	6	6191	12602	1018
Kayunga	Kangulumira	10	5	14071	5468	466
Kibaale	Kibaale	10	8	8580	935	131
Kibaale	Kyebando	11	5	7243	3459	521
Kiryandongo	Diima	10	2	6268	5473	1048
Kiryandongo	Kigumba	11	3	4897	1612	359
Kitgum	Kitgum_Matidi	14	1	5125	4611	771
Kitgum	Namokora	24	4	13979	9056	324
Koboko	Ayipe	13	2	3594	4004	1028
Koboko	Lobule	24	6	8731	23164	1327
Kole	Aboke	11	2	5318	4483	920
Kole	Bala	6	5	13870	3691	532
Kumi	Kamaca	10	4	38648	10679	332
Kumi	Omatenga	13	5	9542	14714	1423
Kwania	Apwori	14	3	7930	9357	1011
Kyegegwa	Kakabara	12	5	21029	2448	116

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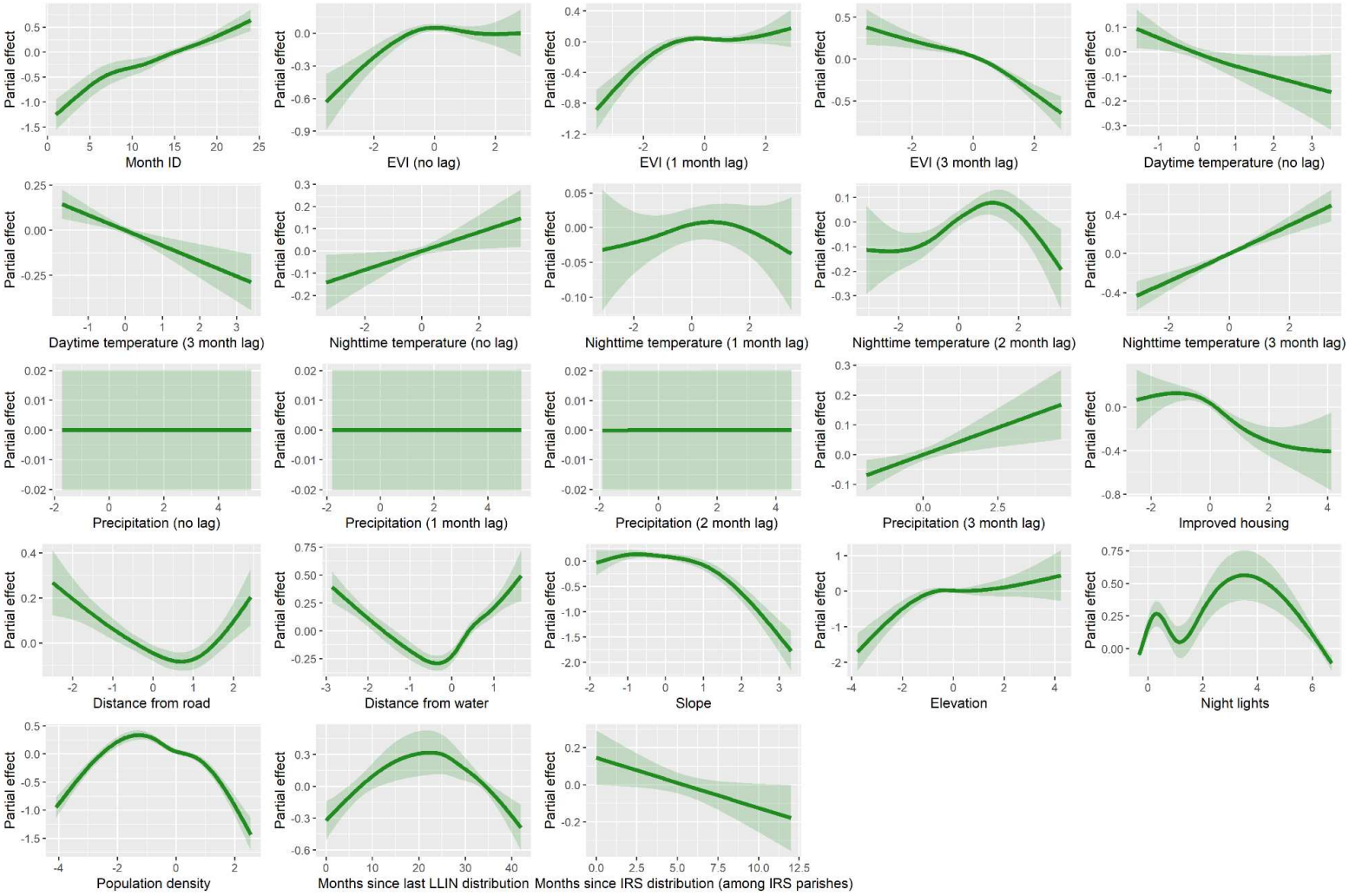
Kyegegwa	Kyegegwa	11	4	16948	1215	78
Lamwo	Madi_Opei	10	4	11089	7077	766
Lamwo	Padibe	24	5	6278	13895	1107
Luuka	Ikumbya	12	4	5453	6690	1227
Luuka	Kiyunga	10	3	15049	4667	372
Masindi	Bwijanga	10	3	10430	884	102
Masindi	Kyatiri	10	1	1537	234	183
Mayuge	Buwaiswa	12	5	11905	5261	442
Mayuge	Kigandolo	11	6	21561	4013	203
Moyo	Lefori	4	2	3381	1386	1230
Moyo	Metu	4	4	6281	1706	815
Mubende	Kasambya	24	1	1113	945	425
Mubende	Kiyuni	11	2	5045	1481	320
Nwoya	Alero	9	3	9135	4207	614
Nwoya	Koch Goma	17	4	16481	19822	849
Omoro	Bobi	11	3	3832	7228	2058
Omoro	Lalogi	24	5	15326	19431	634
Otuke	Orum	24	2	210	309	736
Oyam	Anyeke	24	4	14943	11046	370
Oyam	Otwal	14	6	3989	7523	1617
Rukiga	Kamwezi	11	6	11892	48	4
Tororo	Nagongera	24	7	13906	842	30

Supplemental Figure 4: Smoothed relationships between covariates and outcome.



Supplemental Figure 5: Model diagnostics from generalized additive model