

Supplementary Material

Appendix

The 5 dimensional ODE system yields,

$$\begin{cases} \frac{dS_h}{dt} = \mu_h N_h - \mu_h S_h - \frac{\beta_h I_v S_h}{N_h}, \\ \frac{dI_h}{dt} = \frac{\beta_h I_v S_h}{N_h} - (\mu_h + \gamma_h) I_h, \\ \frac{dR_h}{dt} = \gamma_h I_h - \mu_h R_h, \\ \frac{dS_v}{dt} = \mu_v N_v - \mu_v S_v - \frac{\beta_v I_h S_v}{N_h}, \\ \frac{dI_v}{dt} = \frac{\beta_v I_h S_v}{N_h} - \mu_v I_v. \end{cases} \quad (1)$$

Assuming the total human population N_h and total vector population N_v are constant, Eq. (1) can be reduced to a 3 dimensional model using the relationships, $N_h = S_h + I_h + R_h$ and $N_v = S_v + I_v$. The reduced 3D model is denoted in Eq. (2).

$$\begin{cases} \frac{dI_h}{dt} = \frac{\beta_h I_v (N_h - I_h - R_h)}{N_h} - (\mu_h + \gamma_h) I_h, \\ \frac{dR_h}{dt} = \gamma_h I_h - \mu_h R_h, \\ \frac{dI_v}{dt} = \frac{\beta_v I_h (N_v - I_v)}{N_h} - \mu_v I_v. \end{cases} \quad (2)$$

For simplicity this population model can be converted into a population density model through normalization, $I = I_h/N_h$, $R = R_h/N_h$ and $V = I_v/N_v$ where I , R and V respectively represent the Infected human, recovered human and infected vector population densities.

Rainfall data		Weekly dengue data	
Periodicity (weeks)	Amplitude	Periodicity (weeks)	Amplitude
26	8133.34	26	33192.65
25	3418.90	64	27806.30
9	3022.15	25	27176.03
50	2397.27	70	23202.15
28	2232.80	28	20913.29
35	2210.36	32	20194.93
64	2194.48	59	19757.91
6	2115.71	44	17593.55
4	2030.57	41	15962.05
11	1953.65	23	15081.77
5	1941.69	23	14373.40
7	1913.41	39	13757.62
44	1903.72	78	13633.94
6	1882.97		
31	1866.17		
13	1828.69		

Table 1. The most significant periodic occurrences of weekly rainfall and weekly dengue data captured using the Fast Fourier Transform.

Season No.	Time Span (in weeks)	Estimated a_i	95% credible interval of a_i	SSE
1	1–16	10.78	[9.19 , 12.14]	5.0×10^{-7}
2	16–26	2.13	[0.90 , 3.20]	8.2×10^{-7}
3	26–44	3.51	[2.81 , 4.09]	3.4×10^{-7}
4	44–57	1.79	[1.36 , 2.19]	2.5×10^{-7}
5	57–71	7.17	[6.42 , 7.67]	7.5×10^{-7}
6	71–81	1.13	[0.82 , 1.40]	1.3×10^{-6}
7	81–96	1.85	[0.09 , 4.22]	8.6×10^{-7}
8	96–110	2.34	[0.10 , 5.10]	5.6×10^{-7}
9	110–121	4.57	[3.70 , 5.21]	1.2×10^{-6}
10	121–131	1.04	[0.39 , 1.64]	2.2×10^{-6}
11	131–146	4.70	[2.79 , 6.04]	1.5×10^{-6}
12	146–165	2.10	[0.12 , 4.18]	1.2×10^{-6}
13	165–180	3.92	[2.74 , 4.77]	3.8×10^{-7}
14	180–192	3.42	[0.68 , 5.58]	5.3×10^{-7}
15	192–206	2.51	[0.12 , 5.39]	5.7×10^{-7}
16	206–220	2.37	[0.19 , 4.47]	4.1×10^{-7}
17	220–229	4.72	[4.03 , 5.27]	7.3×10^{-7}
18	229–240	1.59	[1.40 , 1.77]	1.1×10^{-6}
19	240–250	6.15	[4.98 , 7.09]	1.3×10^{-6}
20	250–266	2.18	[1.91 , 2.40]	1.7×10^{-6}
21	266–275	23.86	[16.47 , 28.51]	3.2×10^{-6}
22	275–285	1.84	[0.11 , 3.99]	6.2×10^{-6}
23	285–298	4.36	[3.87 , 4.83]	3.3×10^{-6}
24	298–318	1.91	[0.09 , 4.16]	2.1×10^{-6}
25	318–333	2.21	[1.97 , 2.48]	4.5×10^{-7}
26	333–342	3.47	[2.47 , 4.43]	1.2×10^{-7}
27	342–358	3.65	[3.24 , 4.02]	1.0×10^{-6}
28	358–370	1.64	[0.12 , 3.43]	3.7×10^{-6}
29	370–384	8.37	[7.85 , 8.94]	4.9×10^{-6}
30	384–399	0.71	[0.40 , 0.98]	1.2×10^{-5}
31	399–409	19.49	[12.82 , 23.49]	3.5×10^{-6}
32	409–422	3.27	[1.58 , 4.67]	1.6×10^{-5}
33	422–437	9.79	[8.56 , 10.66]	2.1×10^{-5}
34	437–449	0.41	[0.07 , 0.77]	8.7×10^{-5}
35	449–461	3.54	[2.90 , 4.13]	4.8×10^{-6}
36	461–474	1.34	[0.07 , 2.77]	6.1×10^{-6}
37	474–486	7.62	[6.59 , 8.37]	1.5×10^{-6}
38	486–500	1.55	[0.09 , 3.46]	3.1×10^{-6}
39	500–512	6.04	[4.78 , 7.00]	1.5×10^{-6}
40	512–527	2.30	[1.75 , 2.74]	2.5×10^{-6}
41	527–539	9.62	[8.07 , 10.95]	1.1×10^{-6}
42	539–549	7.01	[5.29 , 8.55]	1.2×10^{-6}
43	549–560	4.10	[3.13 , 4.82]	4.2×10^{-6}
44	560–576	0.62	[0.33 , 0.89]	1.6×10^{-5}
45	576–592	4.17	[2.27 , 5.53]	2.3×10^{-6}
46	592–607	2.02	[1.45 , 2.51]	1.1×10^{-7}
47	607–623	3.36	[0.29 , 5.59]	7.0×10^{-8}
48	623–633	7.23	[5.62 , 8.63]	4.2×10^{-7}
49	633–641	7.14	[5.99 , 8.51]	3.0×10^{-7}
50	641–651	0.86	[0.49 , 1.19]	1.3×10^{-6}
51	651–666	5.89	[5.60 , 6.06]	5.0×10^{-6}
52	666–679	0.52	[0.34 , 0.69]	1.1×10^{-5}
53	679–692	5.37	[3.30 , 6.60]	4.2×10^{-6}
54	692–700	1.58	[1.21 , 1.88]	6.6×10^{-6}

Table 2. Estimated rainfall coefficient parameter values of each season with their credible intervals. Season No. 1 represents 2nd season of 2009 and season No. 54 represents 3rd season of 2022.

Data availability

The data that support the findings of this study are available from the National Dengue Control Unit (NDCU), Ministry of Health, Sri Lanka, but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of the National Dengue Control Unit (NDCU), Ministry of Health, Sri Lanka.