Supplementary material

Table 3 Variance Inflation Factor (VIF) values for climatic predictors across the five study states.

State	Rainfall (mm)	RH (%)	Temp Max (°C)	Temp Min (°C)
Assam	7.93	36.83	55.24	55.54
Bihar	4.51	7.30	18.25	18.86
Odisha	6.73	11.05	35.61	36.02
Uttar Pradesh	4.29	7.82	15.19	13.20
West Bengal	7.09	13.70	30.07	30.67

Note: VIF values greater than 5 indicate moderate multicollinearity, whereas values exceeding 10 indicate substantial multicollinearity among predictors. Elevated VIF values observed for temperature-related variables and RH reflect the strong climatic interdependence characteristic of the monsoon environment in eastern India.

Table 4 Comparison of Gaussian and Poisson GAM model performance across the five study states.

State	Gaussian Pseudo-R^2	Poisson Pseudo-R^2
Assam	0.73	0.98
Bihar	0.90	0.86
Odisha	0.76	0.72
Uttar Pradesh	0.91	0.95
West Bengal	0.90	0.92

Table 5 Diagnostic statistics of the fitted Generalized Additive Models (GAMs) for the five study states.

State	EDoF	AIC	AICc	GCV	Pseudo R^2
Assam	19.85	1001.33	1025.21	2751.85	0.73
Bihar	19.58	290.27	313.38	6.44	0.90
Odisha	19.34	245.51	267.96	4.11	0.76
Uttar Pradesh	19.73	560.19	583.73	68.55	0.91
West Bengal	19.37	353.31	375.85	11.38	0.90

Note: EDoF denotes Effective Degrees of Freedom, AIC denotes Akaike Information Criterion, AICc denotes corrected Akaike Information Criterion, and GCV denotes Generalized Cross Validation score. Higher pseudo-R^2 values indicate better model fit. GAMs were fitted using penalized spline smoothers with a Gaussian distribution and identity link function.

Table 6 Summary of climatic effects on Japanese Encephalitis incidence identified from GAM analysis.

State	Rainfall Effect	Relative Humidity Effect	Maximum Temperature Effect	Minimum Temperature Effect
Assam	Positive non-linear association	Strong positive association	Weak to moderate effect	Strong positive effect
Bihar	Moderate positive association	Positive association	Moderate effect	Strong positive effect
Odisha	Positive non-linear association	Positive association	Weak effect	Positive effect
Uttar Pradesh	Positive association	Moderate positive association	Moderate effect	Strong positive effect
West Bengal	Positive non-linear association	Positive association	Weak effect	Strong positive effect

Note: The table summarizes the general patterns observed from the state-specific GAM partial dependence plots. Detailed non-linear relationships are presented in Figure 5.

Table 7 Results of Augmented Dickey–Fuller (ADF) and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) stationarity tests for monthly JE incidence series.

State	ADF Statistic	ADF p-value	ADF Result	KPSS Statistic	KPSS p-value	KPSS Result
Assam	2.64	0.99	Non-stationary	0.34	0.10	Stationary
Uttar Pradesh	-1.79	0.39	Non-stationary	0.09	0.10	Stationary
Bihar	-1.23	0.66	Non-stationary	0.19	0.10	Stationary
Odisha	0.02	0.96	Non-stationary	0.46	0.05	Non-stationary
West Bengal	-0.73	0.84	Non-stationary	0.14	0.10	Stationary

Note: The Augmented Dickey-Fuller (ADF) test examines the null hypothesis of non-stationarity, whereas the KPSS test examines the null hypothesis of stationarity. The results indicate that most JE incidence series exhibited non-stationary behaviour and therefore required seasonal differencing prior to fitting SARIMA/SARIMAX models.

Table 8 Ljung–Box residual diagnostic test results for the fitted forecasting models.

State	Ljung–Box Statistic	p-value	Interpretation
Assam	15.70	0.15	No significant autocorrelation
Uttar Pradesh	21.12	0.03	Significant autocorrelation
Bihar	8.15	0.70	No significant autocorrelation
Odisha	26.79	0.01	Significant autocorrelation
West Bengal	19.66	0.05	No significant autocorrelation

Note: The Ljung–Box test was used to assess residual autocorrelation in the fitted forecasting models. A non-significant p-value ($p > 0.05$) indicates that the residuals behave approximately as white noise. Most fitted models satisfied this criterion, although significant residual autocorrelation remained for Uttar Pradesh and Odisha, suggesting potential scope for further model refinement.