Overview of Presentation

• Surat Overview

• Climate Model Results for Surat
  – Overview of Climate Models used

• Econometric Model for Malaria Prediction
  – Results for Climate Normals and Future Projections

• Economic Impact Analysis of Public Health Interventions
Surat City- Description

• Ideal Climatic Conditions for Malaria:
  – Mosquitogenic conditions (20–30 °C temperature and 60% relative humidity)
  – Settlement around Tapi River - breeding ground
• Past Cases of Malaria - 1990 onwards
Surat City - Description (contd.)

Public Health Programmes in SMC

- 100% household surveillance system: dispensation of ACTs anti-malarial drugs and follow up of each positive malaria case for next domiciliary visit
- Inspection and treatment of probable breeding grounds - Ongoing construction sites, outdoors water bodies, underground tank, overhead tank, etc.
- Fogging and Spraying by mounted vehicles
- Biological techniques - larvivorous fishes bred and released in water bodies.

Analysis Purpose -

- to develop an urban climate impact assessment model with a focus on public health
  - To establish a disease incidence relationship for malaria within the city
  - Cost-benefit analysis of health interventions (adaptation action)
Climate Models

- City scope is to small for GCMs.
  - Grids ($1^\circ \times 1^\circ$) ~ 111 Km X 111 Km

- Projections based on:
  - Empirical Downscaling (Self Organizing Maps Downscaling Technique)
  - SRES Scenario: A2 (Worst-Case Scenario)
  - Timeframe: 2046-2065
  - Model results for:

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<tr>
<th>Acronym</th>
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<td>Institut Pierre Simon Laplace</td>
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<td>Geophysical Fluid Dynamics Laboratory</td>
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<td>MIUB</td>
<td>MIUB ECHO-G</td>
<td>Meteorological Institute University of Bonn</td>
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Results for Surat

**Climate Normal**

**Future Predictions**

- **Surat Temperature Normals**
  - Graph showing temperature normals from Year 2001 to Year 2010, with temperature in °C.

- **Surat Temperature Projections**
  - Graph showing temperature projections for Year 2016 to Year 2055, with temperature in °C.

- **Surat Precipitation Normals**
  - Graph showing precipitation normals from Year 2001 to Year 2010, with precipitation in mm.

- **Surat Precipitation Projections**
  - Graph showing precipitation projections for Year 2046 to Year 2055, with precipitation in mm.
Econometric Model

- Auto-regressive Integrated Moving Average (ARIMA) to forecast plausible Malaria incidence
- \( Y_t = \varphi_1 Y_{t-1} + \varphi_2 Y_{t-2} + \cdots + \varphi_p Y_{t-p} - e_t - \theta_1 e_{t-1} - \theta_2 e_{t-2} - \cdots - \theta_q e_{t-q} \)

- ARIMA (2,0,0) seen to best represent the Surat Malaria incidence data.
- The modeling results show a strong positive relation between precipitation and minimum temperature and malaria incidence in the time period 1995-2012.
Model Results

- Changed seasonality of incidence
- Lower cases projected in the typical malaria months
Economic Impact Analysis of Public Health Interventions

• Burden of Disease

Cost of Intervention

- Public Programme Costs
- Micro-level Prevention Costs

Benefits of Intervention

- Avoided Man-days lost to illness
- Malaria Treatment Costs
Quantifying Impacts in Surat City

- **Public Health Programme Cost**
  - Rs. 40-50 Lakh

- **Prevention Costs Incurred**
  - ~4 Crore

- **Wage Loss Avoided**
  - ~85 Lakhs

- **Treatment Costs Avoided**
  - ~26 Lakhs

Sources:
- Interview with SMC Health Officials
- NSSO EUS, ASI, Authors' Calculations
- NSSO CES, Authors' Calculations
- Doctors Consultation, Interviews with SMC Health Officials
Thank you for your attention!!