IMPACT OF CLIMATE CHANGE ON RUBBER CULTIVATION IN INDIA

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Session outline

i. Climate change in rubber growing regions over the decades

ii. Impact on natural rubber cultivation

iii. Strategies for adaptation to climate change
i. Climate change in rubber growing regions over the decades
Domestication led to 56% loss of alleles in the last 120 years, resulting in loss of genetic diversity in Asian rubber clones.
NR Growing regions of India

- **Cold-prone NE**
  - (2 ton/ha/yr)

- **Very hot and dry North Konkan**
  - (1.4 ton/ha/yr)

- **Traditional region**
  - Moderate clime
  - (.2 ton/ha/yr)
Maximum temperature (°C)

Day No.

Five-year mean daily maximum temperature, RR II Kottayam between two periods

1957-61

2015-19
Climate warming in traditional rubber growing region

Monthly average temperature - Kottayam

Monthly maximum temperature - Kottayam

Monthly minimum temperature - Kottayam

Average temperature (°C)

Maximum temperature (°C)

Minimum temperature (°C)
Climate warming in traditional region

Mean annual maximum temperature trend for RRS, Padiyoor (1997-2019)

\[ y = 0.1029x - 173.2 \]
\[ R^2 = 0.7654** \]

Mean annual maximum temperature trend for RRII, Kottayam (1957-2019)

\[ y = 0.0446x - 57.213 \]
\[ R^2 = 0.7197** \]
Warming in non traditional region - Agartala

Decadal variation of mean monthly maximum temp $^{\circ}C$
Diff in October - 1.7 $^\circ$C

Decadal variation of mean monthly minimum temperature
Difference 1.2 $^\circ$C in October and December

Decadal variation of mean monthly mean temperature $-0^\circ C$
Difference of 1.4 $^\circ$C in October
1. Both Tmax and Tmin have increased.

2. Number of hot days and warm nights every month have gone up in Kottayam.

3. Number of bright sunshine hours per day showed a decreasing trend.

4. Mean annual rainfall did not show a clear trend, but rainfall distribution has become more unpredictable.

5. Number of extreme weather events and their severity on the rise. (Heavy rainfall, droughts, heat waves, break in monsoon, cyclonic storms etc.)
Temperature has been progressively warming ($T_{\text{max}}$ by 0.04°C/yr in traditional regions and 0.024°C/yr in NE Indian region) and rainfall pattern changing in an unpredictable manner in the NR plantation belts of the country.
ii. Impact on natural rubber cultivation
Future problems likely to affect NR cultivation:

- Decrease in field survival
- Slow growth
- Prolonged gestation period
- Yield depression
- Shift in climatically favourable areas of NR cultivation
- Increase in gestation period
- Increase in disease/pests with new disease/pests emerging?
Vegetation temperature condition index (VTCI) of rubber plantation in Kerala State and Kanyakumari district of Tamil Nadu (based on satellite data)

(lower the value of VTCI, higher the drought and vice versa)

<table>
<thead>
<tr>
<th>VTCI class</th>
<th>Area (ha)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.01-0.30</td>
<td>193101</td>
<td>29.1</td>
</tr>
<tr>
<td>0.31-0.50</td>
<td>354247</td>
<td>53.5</td>
</tr>
<tr>
<td>0.51-0.70</td>
<td>101087</td>
<td>15.3</td>
</tr>
<tr>
<td>0.71-1.0</td>
<td>14015</td>
<td>2.1</td>
</tr>
</tbody>
</table>

Source: Terra MODIS, 1Km
Young rubber plants drying in summer

High temp. + drought + high light stress
Life saving irrigation, which was not a common practice earlier was practiced in 18% of the holdings in the traditional area during summer season in recent years.
As climate warming continues, more areas in North East India may become suitable for growing NR, but traditional areas may become less suitable. Non-traditional areas like north Konkan and central India are likely to become extremely difficult for cultivating this crop.
<table>
<thead>
<tr>
<th>STATION</th>
<th>% Change (for 1°C rise)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NE Region</td>
<td>-1.2</td>
</tr>
<tr>
<td></td>
<td>+ 1.5</td>
</tr>
<tr>
<td>N. Kerala</td>
<td>-8.7</td>
</tr>
<tr>
<td>N. Konkan</td>
<td>-11.4</td>
</tr>
<tr>
<td>Central Kerala</td>
<td>-17.4</td>
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</tbody>
</table>
Ecological Niche (Maximum Entropy) Modeling: More areas in NE (indicated in non-blue colors) will become suitable for NR cultivation in future.
Climate change will seriously dent NR supply in coming years
iii. Strategies for adaptation to climate change
Climate-resilient Agronomic practices

- To prevent excess light falling on leaves, partial shade is advised in nursery plants (30% shade)
- Mulching immature plants
- Allow natural weed flora (dicots) to co-exist with rubber
- Efficient nutrient management
- Life saving irrigation in non-traditional areas (150 litre water/tree/week during summer)
- Partial irrigation (0.5 or 0.25 ETc) in water deficit areas in mature plantation (North Konkan etc)
GENOMIC MARKER ASSISTED SELECTION FOR CLIMATE-RESILIENT HIGH YIELDING CLONES
Expression of stress proteins during drought stress
A 23 kDa chloroplast protein consistently over-expressed in drought tolerant clones
THANK YOU VERY MUCH

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