Flood Risk Assessment Due to the Impact of Climate Change

Background

Sri Lanka is highly vulnerable to climate change impacts. Extreme weather events such as high intensity rainfall followed by flash floods and landslides, and scarce rainfall resulting in droughts and extended dry periods are now becoming common occurrences in Sri Lanka.

Development of Basin Investment Plans (DBIP)

Phase-I River Basins:
- Kelani Ganga
- Attanagalu Oya
- Mahaweli Ganga
- Gin Ganga
- Nilwata Ganga
- Malwathu Oya

Phase-II River Basins:
- Maha Oya
- Deduru Oya
- Kala Oya
- Gal Oya

FLOOD RISK ASSESSMENT

Objectives
- Assess and quantify the risk of flood at a basin scale
- Understand the impact of Climate Change on flood risk
- Help decide what, where & how much to invest to mitigate flood and the negative impacts of climate change

Flood Risk Assessment Case Framework

- Seven (7) Cases
  - Current Condition (Climate & Land Use)
  - 3 x Climate Change scenarios
  - 2 x basin development scenarios

Methodology for Case 01 (Current Situation)

TuFLOW (Flood Modelling Software)

- Digital Elevation Model (DEM)
- Land Use data
- Soil data

Validated Flood Model

Flood Risk (flood depths and inundation area)

Flood Damage Assessment

Economics of Flood Risk
**Methodology for Case 02-04 (Flood Risk Due to the Impact of Climate Change)**

TuFLOW (Flood Modelling Software)
- Calibration and Validation with Observed Data
- Flood Risk Model
- Flood Risk (flood depths and inundation area)

**Hydrological Inputs**
- Design Rainfall Packages for Different return periods (2, 5, 10, 25, 50, 100 & 200)

**Economics of Flood Risk**

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**Methodology for Case 05-07 (Flood Risk Due to the Impact of Climate Change & Basin Developments)**

TuFLOW (Flood Modelling Software)
- Calibration and Validation with Observed Data
- Flood Risk Model
- Flood Risk (flood depths and inundation area)

**Hydrological Inputs**
- Design Rainfall Packages for Different return periods (2, 5, 10, 25, 50, 100 & 200)

**Economics of Flood Risk**

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**Results**

<table>
<thead>
<tr>
<th>Economic Asset</th>
<th>Case 01 Current Cost</th>
<th>Case 02 Cost of Climate Change</th>
<th>Case 05 Cost of Future Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roads</td>
<td>0.64</td>
<td>1.27</td>
<td>1.14</td>
</tr>
<tr>
<td>Railways</td>
<td>0.03</td>
<td>0.05</td>
<td>0.04</td>
</tr>
<tr>
<td>Agriculture</td>
<td>2.53</td>
<td>2.90</td>
<td>2.57</td>
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<tr>
<td>Industry</td>
<td>6.32</td>
<td>10.94</td>
<td>9.96</td>
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<tr>
<td>Trading</td>
<td>7.40</td>
<td>9.96</td>
<td>7.48</td>
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<tr>
<td>Building</td>
<td>1.5</td>
<td>1.50</td>
<td>1.50</td>
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<tr>
<td>Contents</td>
<td>3.2</td>
<td>3.42</td>
<td>3.30</td>
</tr>
<tr>
<td>Vehicles</td>
<td>0.0</td>
<td>0.01</td>
<td>0.0</td>
</tr>
<tr>
<td>Average Annual Damage</td>
<td>22.35</td>
<td>29.67</td>
<td>21.67</td>
</tr>
</tbody>
</table>

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**Summary**

- Climate change is an unpredictable science.
- The results of the study show that the cost of flood damages in all river basins would be increased due to the climate change and this could be further increased due to the developments in the basins expected by the year 2046.
- Accordingly, this indicates that all the six river basins need to be developed against floods in order to reduce the annual socio-economic loss to the country due to the floods.

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**Thank You**
Hydrological Inputs

- Rainfall Packages for different return periods
  - Rainfall Depths (EV1 and PIII)
  - Rainfall Storm Duration (3, 5, 9)
  - Storm Profile (High, Low, Moderate)
  - Areal Reduction Factor (ARF)

Rainfall AMAX seasonality

1-day total 2-day total 3-day total 4-day total 5-day total 6-day total 7-day total

Rainfall AMAX series

Return Period | Probability of Flood | Economic Damage Value (USD million) for Case 01
--- | --- | ---
2 | 0.5 | 0
5 | 0.2 | 47.1
10 | 0.1 | 81.1
25 | 0.04 | 77
50 | 0.02 | 89.8
100 | 0.01 | 102.8

Application of Climate Change

- Marksim stochastic weather generation tool
- Global Circulation Models (GCM) associated with the Representative Concentration Pathways (RCP)

Economics of Flood Risk