Climate Resilient City and Urban Environmental Sustainability

[Bhutan]
Location

[Map showing the location of Bhutan and its regions]
Country profile

- 4 major cities

Bhutan is not only carbon neutral, but also the first carbon negative Country.

Bhutan generates only 2.2 million tonnes of carbon dioxide (CO2), but the forest sequesters more than three times that amount which is about 6 million tonnes of CO2.

In Bhutan, mean annual temperatures are predicted to increase by 0.8°C - 1°C by 2039.
Cities

River system

Thimphu City

Phuntsholing City
Profile

Country’s Population: 807,610

Thimphu city= 126,000
Gelephu City= 41,000
Phuntsholing City= 65,000
Samdrup Jongkhar City= 37000

Area: 38,394 km²

Demographic density:
21 people per square kilometer of land area

Height above sea level : 210 m and above

Human Development Index: 132

GDP of the country: 2.237 billion USD $

GDP per capita: 2,804 USD $
Specific CCA/M and urban environment issues faced by Cities in Bhutan

1. Accelerated melting of glaciers, formation of Glacial Lakes and GLOF

- In 1984, no water body
- After the formation of Lake, rapid retreat observed
- Roughly 500m retreat in 25 years (high retreat rate)
Specific CCA/M and urban environment issues faced by Cities in Bhutan

2. Flooding
Specific CCA/M and urban environment issues faced by Cities in Bhutan

3. Drying up of fresh water resources
Specific CCA/M and urban environment issues faced by Cities in Bhutan

4. Heat Island Effect
## Goals and Objectives

<table>
<thead>
<tr>
<th>Sl. no</th>
<th>Issues/ Problems</th>
<th>goals</th>
<th>Objectives</th>
</tr>
</thead>
</table>
| 1.     | Accelerated melting of glaciers leading to formation of Glacial Lakes and GLOF | ✓ Assess GLOF risk in Bhutan and attempt to implement adaptation and prevention measures to curb both existing and future GLOF-related risks | ✓ To reduce the emission of GHGs  
✓ To prepare for the impact of GLOF  
✓ To enhance awareness raising, mobilize effective commitment and actions through bringing together policy makers, academicians and practicing stakeholder with the aim of effectively mainstreaming glacial lake out burst. |
| 3      | Drying up of fresh water resources | ✓ Integrated plan to sustain the fresh water sources | ✓ To provide measures to prevent the drying of water sources  
✓ To create awareness among the people |
| 4      | Heat island effect | ✓ To make Bhutan cities climate resilient by increasing its adaptive capacity via Climate SMART Land Use Planning (LUP); and to promote climate resilient urban services and infrastructure | ✓ To review the Urban Development Plan for stocktaking and identifying entry points for the incorporation of land use planning components that are climate SMART (Sustainable Mitigation & Adaptation Risk Toolkit);  
✓ To carry out a detailed inventory of existing urban critical infrastructure and services that would be improved for climate resilient measures.  
✓ To enhance the capacity of local Governments to plan and implement Climate SMART Cities. |
## Action plan

<table>
<thead>
<tr>
<th>Sl. no</th>
<th>Issues/ Problems</th>
<th>Mitigation</th>
<th>Adaptation</th>
</tr>
</thead>
</table>
| 1.     | Accelerated melting of glaciers leading to formation of Glacial Lakes and GLOF   | ✓ Bring the world together to reduce the emission of GHGs.  
✓ Encourage to go green. | ✓ Create awareness about the chances of GLOf.  
✓ Identifying the possible area which will be affected and implement measures to prevent the disaster  
✓ Comprehensive inventory of Glacier lakes.  
✓ Reduce the natural flow regulating capacity of the glaciers with serious consequences on our water resources. |
| 3      | Drying up of fresh water resources                                               | ✓ Drip irrigation/Plantation  
✓ Effective watershed management for conservation and sustainable utilization. | ✓ Sensitize on minimizing the wastage of water.  
✓ Reduce, reuse and recycle.  
✓ Rainwater harvesting  
✓ Source conservation  
✓ Ecological sanitation  
✓ Water policy |
| 4      | Heat island effect                                                                | ✓ Create Parks and Open Green Spaces  
✓ Urban Forest  
✓ Promote Urban Garden | ✓ Energy efficient infrastructure  
✓ Integrated Green Transportation  
✓ Green Building Codes  
✓ Smart city Planning  
✓ Install green roof or roof top garden.  
✓ Construct permeable pavements instead of concrete surfaces.  
✓ Use energy efficient appliances and equipment's. |
Needs of the cities in Bhutan for urban environment sustainability

- An ecosystem approach (Biodiversity)
- Reduced carbon footprint
- Efficient use of resources
- Green Building
- Clean air (quality) and human Health
- Sustainable Communities (group of people, well informed, share common interest, consensual decision making)
- Economic opportunity
- Conserve green urban forests
Institutional structure of the local Governments
## Governments initiatives

<table>
<thead>
<tr>
<th>Sl. no</th>
<th>Issues/ Problems</th>
<th>Specific actions</th>
</tr>
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</table>
| 1      | Accelerated melting of glaciers leading to formation of Glacial Lakes and GLOF  | ✓ In its NDC, Bhutan reaffirmed its goal to remain carbon neutral, by ensuring that GHG emissions will not exceed the sink capacity of its forests.  
✓ Ensuring at least 70% forest cover.  
✓ Set up early warning systems for GLOF.  
✓ Flood Simulation and Hazard map  
✓ Training on Glaciological survey, Satellite data analyses, Geotec laboratory, etc… |
| 3      | Drying up of fresh water resources                                                | ✓ Proposal for the Integrated Water Resources Management (IWRM) (2016)  
✓ Integrating IWRM plans in sectoral priorities through the government’s planning, budgeting, implementing, and monitoring processes  
✓ Management Plan for a priority basin, the National Irrigation Master Plan (NIMP), and to strengthen water resources governance. |
| 4      | Heat island effect                                                                | ✓ Development Control Regulations.  
✓ Encouraging Vernacular approach  
✓ Giving importance for urban greens and pedestrian walkways. Eg. Transforming the exiting road way to pedestrian (Norzin lam) in the core area of the Capital.  
✓ Structure plans for different cities for urban environment management |
Initiatives

- Wind mill- Energy generated 1.5 Mw
- Hydro power- Energy generated 1,615 Mw
- Recycling of waste
- Flood depth simulation
## Stakeholder Analysis

<table>
<thead>
<tr>
<th>Stake Holder</th>
<th>Impact How much?</th>
<th>What is important to Stake holder?</th>
<th>Contribution of the Stakeholder to the Project?</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Environment Commission Secretariat</td>
<td>High</td>
<td>Prevent environmental degradation</td>
<td>Providing environmental information's, clearance, etc.</td>
</tr>
<tr>
<td>Ministry of Works and Human Settlement</td>
<td>High</td>
<td>Minimize risks to the urban infrastructure and human settlement</td>
<td>Mobilize Technical capacity and ICT based support</td>
</tr>
<tr>
<td>Ministry of Finance</td>
<td>High</td>
<td>Cost and value evaluation</td>
<td>Acquire Budget from within and global CCA/M organizations.</td>
</tr>
<tr>
<td>Natural Resources Development corporation Limited</td>
<td>High</td>
<td>Maintaining sustainable resources for the present and future</td>
<td>Supplier of natural resources as construction materials at the most affordable rates and in sustainable manner.</td>
</tr>
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<tr>
<td>Department of Disaster Management</td>
<td>Medium</td>
<td>Safety through disaster risk reduction</td>
<td>Coordinate disaster risk management at the national and local levels in coordination with relevant agencies</td>
</tr>
<tr>
<td>Local Governments</td>
<td>Medium</td>
<td>Sustainable urban environment management</td>
<td>Implantation and monitoring</td>
</tr>
<tr>
<td>Public</td>
<td>Low</td>
<td>Healthy environment</td>
<td>Active participation and community vitality</td>
</tr>
</tbody>
</table>
Challenges and Opportunities

Challenges
- Human resources
- Technical
- Financial
- Topography

Opportunities
- Increase the renewable energy production.
- Minimal GHGs emission - Role model
- Clean and green city
- Enhanced air quality
Important topics for training

- Glaciological surveys
- Land and lake surveys
- Satellite data analyses
- Flood analyses with GIS
- Soil testing in geotech Laboratory
- Flood analyses and planning

- Groundwater exploration
- Smart technology for water management
- Green building/ green city
- Smart city
- Environment conservation and preservation techniques
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### SWOT Analysis

<table>
<thead>
<tr>
<th>Sl. no</th>
<th>Issues</th>
<th>Strengths</th>
<th>Opportunities</th>
<th>Weakness</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Accelerated melting of glaciers leading to formation of Glacial Lakes and GLOF</td>
<td>1. Torrential River Flow enabling renewable Hydropower generation</td>
<td>1. Capacity to produce more renewable energy.</td>
<td>1. Shortage of water sources</td>
<td>1. GLOF</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Reduction in GHGs emissions</td>
<td>2. Drying up of fresh water resources</td>
<td>2. Variation in seasonal water flow</td>
<td>2. Drying up of Water source due to Global warming</td>
</tr>
<tr>
<td>2.</td>
<td>Flooding and drought</td>
<td>Nil</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Drying up of fresh water resources</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>4.</td>
<td>Heat island effect</td>
<td></td>
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