Vision for Development of Georgia's High Mountainous Regions adapted to the Climate and Landscape Changes

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3rd EURO-ASIAN MOUNTAIN RESORTS CONFERENCE

4 - 7 April, 2017, Tbilisi, Georgia
Caucasus – June 1984
Chokheltkari - 1987
Murkmeli-Ushguli, 1956.
Murkmeli-Ushguli, 2007
Jamushi-Mulakhi, 1895.
Jamushi-Mulakhi, 1987
Devdoraki, 2014
Jabeshi-Mulakhi, 2016
New Problem!

Eiger Rockslide - Progression of Movement

- Estimated position of glacier surface 1860
- Volume 2 mio m³
- Sliding surface
- Mountain water
- Glacial runoff

- Subsidence of approx. 70 m
- Lateral movement of approx. 10 m
- Debris
- Plastic deformation of the ice
- Glacier (Dead Ice)

1600 m a.s.l.
1400 m a.s.l.
Concept – Process Chain

Magnitude - Probability-Analysis

Damage potential
New Risky Areas

GEORGIA

Mestia Municipality
Sensitive Villages
Ethno-Ecological Degradation, Mulakhi - 2016
Growing Economy - Regional Development
Regional and Municipal Plans
Tourism
Master Planning
<table>
<thead>
<tr>
<th>Values of Spatial Categories</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety</td>
<td>51</td>
</tr>
<tr>
<td>Ethno-Cultural Heritage</td>
<td>15</td>
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<tr>
<td>Natural Environment</td>
<td>15</td>
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<tr>
<td>Other Resources and . . .</td>
<td>19</td>
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<tr>
<td></td>
<td>100</td>
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</tbody>
</table>
Mapping the Road Map:

SEEING is KNOWING

Exposure Subsystems

Water  Urban  Agricultural  Natural  ALL
**IMPACT MATRIX**

\[
\text{Impact} \propto \text{Sensitivity} \times \text{Change in Exposure}
\]

**SENSITIVITY INDICATORS**

| Physical sensitivity | Municipalities’ sensitivity to landslides | x | x | x | Municipalities’ sensitivity to debris-flows, flash floods, and mudflows | x | x | x | Municipalities’ sensitivity to river floods | x | x | x | Municipalities’ sensitivity to avalanches | x | x | x | Motorways’ sensitivity to river floods | x | x | x | Social sensitivity | Population sensitivity to summer heat | x | x | x | Population sensitive to natural disasters | x | x | x | Agricultural sensitivity | Agriculture sensitive to soil moisture | x | x | x | Agriculture sensitive to water and wind erosion | x | x | x | Forestry sensitive to forest fires | x | x | x | Tourism sensitivity | Summer tourism sensitive to summer temperatures | x | x | x | Winter tourism sensitive to snow cover changes | x | x | x | Protected natural areas sensitive to different climate exposures | x | x | x | Cultural heritage sites sensitive to river flooding and avalanches | x | x | x | Museums sensitive to river floods and avalanches | x | x | x | Energy sector sensitivity | Energy demand correlated to summer heat (HDD) | x | x | x | Energy demand (CDD) | x | x | x | Cooling load | x | x | x | Heating load | x | x | x | Energy supply sensitive due to changing river water levels and hydrology | x | x | x | Physical infrastructure sensitivity to river floods and avalanches | x | x | x |
IMPACT ASSESSMENT SYMBOLOGY

\[ \text{Impact} \propto (\text{Sensitivity} \times \text{Change in Exposure}) \]

CHANGE AND CHANGE FOR THE BETTER ARE TWO DIFFERENT THINGS.
MAKE A DIFFERENCE.

INSTITUTIONALIZATION OF CLIMATE CHANGE ADAPTATION AND MITIGATION IN GEORGIAN REGIONS.
FUTURE 2071-2100
Exposure, Sensitivity

Natural Hazards Exposure (low – medium – high)
Tourism Sector

- Impacts to Georgia:
  - Tourism comprises 6 percent of Georgia’s GDP;
  - The further growth of this sector, together with other economic factors, are greatly dependent on the environment, climate changes and the ability of municipal governments to implement adaptation measures;
  - The evaluation of climate change impacts on the tourist industry, as well as the planning of appropriate adaptation mechanisms are important for the future development of eco-tourism and the overall environmental potential to support these activities.
The map displays the sensitivity of the tourism sector to potential climate change impacts. The tourism sensitivity indicator is calculated the ratio of the total number of beds in hotels/hostels with the relevant population size. This indicator reflects the economic importance of tourism to a particular municipality as it indicates actual and potential employment opportunities.

As indicated by the map, Kazbegi and Borjomi Municipalities, both of which have active tourist sectors, have a very high sensitivity to climate change. The Mestia Municipality has a high sensitivity as the area has witnessed development in its tourist sector over the last several decades. These three municipalities are located within the mountainous zones as Kazbegi and Mestia are within the Great Caucasus, and Borjomi is located in the Georgian southern highlands.

These municipalities all have well-developed tourist sectors, hence their high sensitivity.
TOURISM EXPOSURE INDICATORS USED

- Relative change in seasonal mean precipitation for summer tourism
- Change in annual mean snow cover (CDSC) depth for winter tourism
CC IMPACTS ON TOURISM 2021-2050
The map presents the potential impact of climate change on tourism for the period of 2021-2050. The climate change impact on tourism is calculated by combining indicators/values of the climate change impact on summer and winter tourism (mean value).

The forecast for 2021-2050 indicates a decline in the mean annual number of snow days, which will negatively impact the winter tourism centers located in Kazbegi, Mestia and Borjomi Municipalities.

In addition, the forecast for 2021-2050 indicates a precipitation increase during the summer and autumn seasons, which will impact seashore resorts. Those resorts located in the Kobuleti and Ozurgeti Municipalities will be negatively impacted.

During the period of 2021-2050, the forecasted increases in air temperature combined with decreases in summer precipitation decrease will prolong the tourism season, but reduce the number of tourists during peak tourist season, i.e. summer. In some municipalities, the average impact with be positive and will be potentially observed in Ambrolauri, Telavi and Akhaltsikhe.
Recommendations for Tourism Sector

- It is recommended that the relevant Georgian Ministries develop a sustainable tourism plan integrating the potential impacts of climate change;
- It is recommended to develop a municipal based climate monitoring system that focuses in a variety of disciplines such as climatology, bio-geography, hydrology, geomorphology, tourism geography;
- It is recommended that general infrastructure, such as roads, transport and water supply networks, be further improved and supplemented. These work should be performed with due regard to potential climate change trends and probable natural hazards caused therein;
- In developing and planning future tourism activities, the promotion of alternative kinds of winter tourism, a particularly vulnerable sector, and the sharing of international experience from the Alpine region, should be taken into account.
Synoptic map of hazards

- Flood
- Landslide
- Rock fall
- Avalanche

Vitznau
HazMap into land-use plan

- **Considerable hazard:** construction of new buildings prohibited
- **Medium hazard:** construction only allowed with restrictions
- **Low hazard:** local protection recommended
Risk Assessment and Zoning

- accepted risk
- not accepted risk
NEA and GeoG HazMaps
Land Information System
Public Discussions
Integrated Spatial Plans – Good Master-Plans
Integrated Municipal Spatial Plans
Steps of Development

- Focused Studies
- Modeling Scenarios
- Integrated Vision
- Adaptation Guidelines
- Integrated Planning
- Zoning and Regulations
- Adapted Design/Redesign
- “Green” Construction
- Precise Operation
- Integrated Management
URGENT STEPS – ASAP!

Figure 2 shows for example the potential increase in debris flow discharge.

4. Results – Debris Flow

Periglacial Hazard Indication Map: A Basic Instrument in Prospective Hazard Management

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⁵ Federal Office for the Environment FOEN, 3003 Berne, Switzerland
1. Start of surveys and monitoring - URGENT!

2. Modeling, processing of scenarios and zoning;

3. Revision of sectoral visions and consolidation into the unified integrated vision;

4. Processing of unified integrated planning and regulatory document/s;

5. Integrated management using modern technologies;

6. General and specialized education system adaptation to climate change challenges.
To avoid:

Public School - Tbilisi, Vere Valley, 2015
Thank You...