AGENDA FOR CLIMATE ACTION
TRANSPORT

Linking the Vulnerability and Risk Assessment for Uttarakhand with policy implications for the State

Prepared under the project, “strengthening State strategies for Climate Actions” being implemented by United Nations Development Programme (UNDP) and State Climate Change Centre, Uttarakhand. The project is funded by Swiss Agency for Development Cooperation (SDC)

NOTE: This sectoral brief focuses on road, rail, and air-based transport. Climate impacts related to roads (as a component of the State’s infrastructure) are addressed in a separate sectoral brief on roads. While the two are interconnected, this distinction is in line with the framing of the Uttarakhand Action Plan on Climate Change (UAPCC), which addresses each as a separate sector. For guidance on climate resilient policies linked to roads refer to the ‘Agenda for Climate Action: Roads.’
1. OVERVIEW OF TRANSPORT SECTOR IN UTTARAKHAND

The transport system in Uttarakhand consists primarily of road, rail, and air transport. Transport by road remains the predominant mode of transport in the State. Rail connectivity is not as extensive as 88% of the State's geographic area is mountainous, making it difficult to build and maintain rail networks. As of 2013-2014 there were 345 km of railways, primarily in the plains. The State has two airports with domestic scheduled flight operations in Dehradun and Pantnagar.

The State's road network of 41,041 km supports various vehicle types, 73% of which are two-wheelers and 16% of which are cars or jeeps. The number of vehicles on the roads has been rising steadily, experiencing about a five-fold increase from 2000-2001 to 2014-2015. At the last count, 1,900,962 vehicles were registered with the State, and most (90%) serve as personal transport.

The Uttarakhand Transport Corporation (UTC) provides bus services on national and inter-state routes. Currently over 1,000 buses are operated by UTC on 35 nationalised routes as well as other non-nationalised routes. Around 3,000 buses are used by private transport operators on non-nationalised routes, along with a few inter-state routes in Uttarakhand and Uttar Pradesh.

Buses that run in the hills have a smaller wheel base (distance between the centres of the front and rear wheels) and an overhang of 50% or less; this design is better suited to hill routes. Buses that run on plains routes have a larger wheel base and overhang as well as greater seating capacity.

The rapid growth in the number of vehicles on the roads has brought with it a number of issues, including traffic congestion, a lack of adequate parking space, high accident rates, a rise in environmental vehicular pollution and inadequacy of road space for efficient public transportation. The State Transport Department must cater to the public transportation needs of not only its population of over 10 million, but also the significant floating population made up of tourists and pilgrims.

Recent initiatives have been taken to improve the transport system in the State. For example, Uttarakhand recently signed an agreement with the Delhi Metro Rail Corporation to introduce metro rail transport between Haridwar, Rishikesh and Dehradun in an effort to improve commutes and boost tourism. The State will also soon begin construction of a new 125 km rail line from Rishikesh to Karnprayag, including India's longest tunnel; this route will reduce travel time and cost for pilgrims as well as speed up transportation of defence personnel and equipment to border areas.

In Uttarakhand's high-altitude hilly regions, transport connectivity is a challenge due to the difficult terrain. The construction of ropeways (gondolas) has been suggested to help connect hard-to-reach places, particularly for tourists.

Box 1: Observed trends linked to transport sector vulnerability

- Most villages cited a lack of access to public transport facilities, regardless of whether or not they are well connected by roads
- Two of the villages use shared taxis or private buses to travel to nearby towns and markets; in two villages there are fewer transport options.
- In the village of Bhikkampur, 90% of households have their own two-wheelers.
- Majuli is the only village that is well-connected by road, which has greatly contributed to its socioeconomic development.
2. CLIMATE VULNERABILITY OF THE TRANSPORT SECTOR IN UTTARAKHAND

Climate-related efforts in the transport sector normally focus on mitigation, the reduction of greenhouse gas emissions, particularly through stricter emission requirements for vehicles. However, the sector is also vulnerable to the impacts of climate change, particularly increased temperatures and flooding.

No climate vulnerability and risk assessments (VRA) have been carried out for the transport sector to date in Uttarakhand, however insights can be drawn from the existing VRA as well as global literature. Overall, changes in climate such as more frequent and severe heat waves and increased extreme precipitation could cause an increase in the risk of delays, disruptions, damage, and failure across transport systems, both land and air based. Findings point to the following areas of future impact on transport:

1. Rising temperatures
2. Increased risk of flooding and landslides

2.1. Rising temperatures

According to the VRA, under both scenarios and timelines, mean annual maximum temperatures in Uttarakhand are projected to increase. Under the moderate and extreme scenarios and across both timelines, the highest maximum temperature increases are projected in the winter season (January and February), as well as the pre-monsoon season (March, April, May) under the extreme scenario.

In addition to increased temperatures, the VRA also projects increased humidity levels in across time-lines and scenarios. The combined effect of temperature and humidity on human body is measured by humidex which is an index number to describe how hot the weather feels to the average person. A humidex of over 90 warrants extreme caution, above 103 indicates danger and above 125, extreme danger. Increases in temperature and humidex values are likely to increase motorist discomfort and exhaustion, with the implication that road safety is compromised.

Increases in temperature may lead to a number of impacts on transport including:

Road based transport: Higher temperatures can cause an increase in motorist discomfort and exhaustion, in turn leading to a road safety hazard. Melting tyres or wearing tread and overheating of petrol and diesel engines can also lead to an increased road safety hazard. Excessive heat can lead to increased demand for cooling and thus the use of costly and more energy-intensive air conditioning systems in cars.

Rail based transport: High temperatures may cause rail tracks to expand and buckle. Increased frequency and severity of heat waves may require track repairs or the imposition of speed restrictions to avoid derailments.

Air based transport: Increased temperatures and humidity may affect aircraft performance, restrict take-off weights, increase fuel requirements and increase runway lengths, leading to increased operational costs.

2.2. Increased risk of flooding and landslides

Uttarakhand, like all Himalayan states, is prone to heavy monsoon rainfall, landslides, and floods, which can lead to disasters such as the June 2013 floods. Within the transport sector, increased flooding can lead to transport disruptions to road-based vehicles or trains. Furthermore, landslide risk is projected to increase in the State, posing a danger to drivers and passengers of cars and trains.

The VRA indicates that flooding may increase in future; the magnitude of peak discharge is projected to increase towards end-century compared to the mid-century. Projections under both scenarios suggest increased precipitation during the monsoon season, most likely in the form of isolated heavy rainfall events, which, in combination with other circumstances, will lead to flooding. A risk analysis conducted for Uttarakhand, using the VRA projections, focuses on two major impact areas, namely floods and landslides. The analysis treats the impact of climate change on basic infrastructure, namely roads, major bridges, hospitals, communication systems, electric lines, and hydroelectric stations, as a combined risk; while it does not focus on effects on transport specifically, there are clear implications for the sector.

Based on the modelled simulations of the risk analysis report, four districts are projected to be at high risk from floods in all scenarios by the end-century (see Table 1).

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1. Scenarios refer to Representative Concentration Pathways or RCPs, which are greenhouse gas concentration trajectories adopted by the Intergovernmental Panel on Climate Change (IPCC) to describe four possible climate futures, depending on how much greenhouse gases are emitted in the years to come.
According to the risk analysis report conducted for the State, the frequency and spread of landslide hazards are projected to increase in the mid and end-centuries linked to increase in rainfall intensity. The risk continues to be focused in parts of the middle transect of the State, expanding outwards. The rest of the State continues to be in the moderate risk zone across scenarios and time-lines. Eight out of the 13 districts, i.e. over 60% of the State are projected to be at high risk from landslides in all scenarios by the end century (see Table 2).

<table>
<thead>
<tr>
<th>Risk index</th>
<th>Districts</th>
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<tbody>
<tr>
<td>High</td>
<td>Almora, Bageshwar, Chamoli, Pauri Garwal, Pilhorgarh, Rudraprayag, Tehri Garwal, Uttarkashi</td>
</tr>
<tr>
<td>Medium</td>
<td>Champawat, Dehradun, Nainital</td>
</tr>
<tr>
<td>Low</td>
<td>Udham Singh Nagar, Haridwar</td>
</tr>
</tbody>
</table>

Overall, results indicate more frequent occurrences of climate-related hazards such as flooding and landslides, with negative consequences for transport networks including:

Road based transport: difficult driving conditions or circumstances where driving becomes impossible (such as roads that are flooded or blocked by landslide debris), leading to increased road safety hazard as well as travel disruption.

Rail based transport: flooding and landslide may impact railway infrastructure, disrupt timetables and increase safety hazard of railway operations.

Air based transport: increase in the frequency and duration of storms may disrupt timetables.

4. CLIMATE POLICY LANDSCAPE

The key document linked to climate change and the transport sector in Uttarakhand is the Uttarakhand Action Plan on Climate Change (UAPCC). Under the chapter on transport, the UAPCC considers primarily road vehicles and does not address rail or air transport. These are both primarily Union subjects, with state-level bodies overseeing policy and operations. It is important that in its next revision, the UAPCC also consider climate vulnerability and resilience of these two modes of transport.

The State Transport Department is the main authority overseeing transport and road safety in the State. The Uttarakhand Transport Corporation (UTC), a state-owned passenger road transport corporation, provides bus services within the State and other adjoining states. While state road transport policies do not refer to climate change, the taxation system provides at least one relevant incentive, in that vehicles operated by electric battery or solar power are exempt from tax, and vehicles operated by ethanol mixed fuel are subject to reduced tax.

The Transport Department has published a handbook for drivers on road signs and road safety, which recognises that one of the common driving mistakes is failing to adjust to adverse weather conditions, such as slowing down in rain, allowing for longer stopping distances and adjusting to poor visibility. It also includes more detailed guidance on driving in the rain; these guidelines could be updated to include guidance on what to do in an emergency such as a flood or landslide.

3. LIMITATIONS OF THE VRA

It is important to note that the VRA results do not take into account flooding due to events such as cloudbursts, which could further increase the risk of devastating impacts across sectors, including transport. The impact assessment also does not factor temperature changes over time which can lead to snowmelt and Glacial Lake Outburst Floods (GLOFs), further exacerbating floods and landslides.

3.1. On-ground vulnerability and coping strategies

The PRA gives limited indication of vulnerabilities and coping strategies directly related to transport, since this was not a sector of focus during village visits. Current on-ground vulnerabilities linked to the transport sector have been outlined in Box 1. The primary observation with respect to transport in villages is the lack of public transport facilities, even though some villages have decent road connections. For example, Bhikampur (Haridwar) has a well-developed road network, but villagers say poor access to local transport has hampered access and connectivity. Partly for this reason, 90% of households have their own two-wheelers. Weather already has an impact on transport in villages; in Kantali, vehicle mobility is severely hampered during the monsoons.
domestic and international airports in India. The National Policy on Civil Aviation of 2016 includes a section on sustainable aviation which calls for the strengthening of policy guidelines on energy conservation, sustainable practices, improvements in emission measurement and information dissemination; training and awareness building. The Uttarakhand Civil Aviation Development Authority (UCADA) is the state-level authority on aviation, including helipads, heliports, and airports.

At the national level, the transport sector is an important component of India's NDC, which aims to mitigate and better adapt to climate change by enhancing investments in development programmes in various sectors, including a "safe, smart and sustainable transportation network". This includes investments in energy efficient railway networks, metro rail, vehicle fuel efficiency, and biofuels, among others. Interventions that implement and deliver NDC objectives are likely to be eligible for international finance from bilateral and multilateral development partners.

Transport policies and plans in Uttarakhand would benefit from a review in light of the findings of the VRA and risk analysis report, in order to help manage areas of current and emerging risk due to climate change. Some of the relevant transport policies and schemes to be examined are:

- Uttarakhand Motor Vehicles Act (1988)
- Uttarakhand Motor Vehicles Rules (2011)
- Uttarakhand Road Safety Policy (2016)
- Handbook for drivers on road signs and road safety
- Policy on Airports (1997) (national)
- National Policy on Civil Aviation (2016)
- Indian Railways Vision and Plans 2017-2019

Finally, a top-down vulnerability and risk assessment as well as a bottom-up study focusing on specific impacts of increased temperatures and risk of flooding and landslides on the sector should be undertaken.

## 5. Agenda for Climate Action

The following table suggests areas of action to be undertaken in the transport sector over the next five years based on findings of the top-down VRA, a bottom-up review of community trends, and a review of existing State and national priorities.

<table>
<thead>
<tr>
<th>Impact Area</th>
<th>Action</th>
<th>Type of intervention</th>
</tr>
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</table>
| Rising temperatures                   | • Integrate heat-related early warning systems into the State's Road Safety Policy and Handbook for drivers  
• Revise design standards for vehicles, including tyres and engines, to withstand higher temperatures  
• Explore potential requirement for heat-resistant technologies and design standards for railways and aircraft/airports | Strengthening existing initiatives  
Strengthening existing initiatives  
Information and research                  |
| Increased risk of flooding and landslides | • Assess feasibility of setting up ropeways and gondolas to help eliminate road congestion and reduce emissions, as recommended in the UAPCC  
• Strengthen early warning and emergency response systems to help ensure minimal impact to motorists; for example, alert drivers to changing weather conditions based on monitoring and forecasting results and provide guidance on how to manage risks  
• Conduct climate risk screening for future infrastructure projects including road and rail networks  
• Integrate guidance on how to act in landslides/flood situations into the State's Road Safety Policy and Handbook for drivers  
• Examine modelled and observed flood and landslide zones while planning new rail development and aviation infrastructure (including emergency helicopters and heliports) | Information and research  
Information and research  
Strengthen existing initiatives  
Strengthen existing initiatives  |

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<tr>
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| Reducing emissions and dependence on fossil fuels | • Promote consumer information and organise campaigns for efficient driving, ride-sharing and use of public transport  
• Increase the supply of public transport vehicles, eg, the UAPCC's recommendation to purchase 800 new buses to meet increased demand for efficient public transportation  
• Phase out UTC's older buses and replace them with Bharat Stage 3-compliant vehicles, as per the UAPCC. Include fuel efficiency and climate resilience considerations in future purchases of buses  
• Provide driver training on fuel efficiency at the state-of-the-art motor training facilities at Paul and Almora, as per the UAPCC  
• Promote the use of alternative fuels such as CNG and bio-diesel in the State for public and private transport; promote solar and electric powered vehicles in urban areas where possible  
• Consider introducing an environmental cess on tourist vehicles entering Uttarakhand | Strengthen existing initiatives  
Strengthen existing initiatives  
Strengthen existing initiatives  
Strengthen existing initiatives  
Capacity building  
Strengthen existing initiatives |
| Transport policies not aligned with climate impacts | • Review transport policies and plans in light of the findings of the VRA and risk analysis report, in order to help manage areas of current and emerging risk due to climate change  
• Conduct a top-down vulnerability and risk assessment as well as a bottom-up study focusing on specific impacts of increased temperatures and risk of flooding and landslides on road, rail and air transport  
• Initiate coordination between state bodies responsible for various modes of transport in order to help guide climate-resilient decision making in a comprehensive manner | Policy review and mainstreaming  
Information and research  
Cross-sectoral action |

6. DEVELOPMENT CO-BENEFITS

The suggested areas of climate action in would lead to the following development co-benefits:

• Benefit tourism by de-congesting traffic in tourist towns
• Increased road safety due to better preparedness of drivers and passengers
• Increased mobility for poorer populations who cannot afford private transport (by increasing public transport)
• Improve health, ecosystem and biodiversity outcomes through reduced air pollution
• Increased fuel/energy security due to diversification of energy sources, reduced dependence on fossil fuels and exposure to oil price volatility
REFERENCES


Ibid.


Ibid.


Ibid.

Geo Climate Risk Solutions (2016). Risk Analysis of Basic Infrastructure in Uttarakhand with Specific Focus on Flood and Landslide Related Risks.
