Infra Development Vision for Himalaya in the Aftermath of Rishiganga Tragedy

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Abstract

Rishiganga tragedy of February 7th, 2021 in Uttarakhand has been an astonishing experience for the masses. However, this event might not have been very unusual for the geoscience fraternity which is well versed with the multi hazard proneness of Himalaya. As of now the plausible causes for this event vary from a combination of detached rock mass and slur waves to that of avalanche and debris flow. The question then arises, "Can we really afford to oppose infrastructure development in Himalaya by citing the multi-hazard proneness of this region to earthquakes, landslides and cloud burst induced flash floods?" Are these multi-hazard prone, socio-economically backward but strategically significant hinterlands of Himalaya destined to remain backward for these obvious reasons? Rather than stopping infrastructure and power projects, it is the reduction in vulnerability that is key to disaster mitigation in Himalaya. There is a dire need for taking up some important infrastructure planning initiatives for recalibrating our ongoing and future projects of infra and power sector. An Integrated Centralized Forewarning System can be a potential game changer in enhancing resilience of the vulnerable groups viz. construction workers, local populace and the floating population. Most of the urban agglomerations in hill areas are coming up along the roads. This calls for planning the new alignments on relatively stable upper hill slopes beyond the limit of high floods. Since the urban agglomerations along such roads could fall beyond the maximum water level of high floods. Our strategy for Himalaya should not be centered around the concept of long loops of environmental clearances and termination or non initiation and or delays in infrastructure and power projects. It should in fact be aimed at greater access and connectivity to the Himalayan hinterlands through safer roads, railway, communication

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network, uninterrupted power supply lines with elements of river management and disaster resilience embedded in such projects.

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1. Introduction

The recent Rishiganga tragedy of February 7th, 2021 in Uttarakhand has been an unfortunate event with element of astonishment. The catchments of Rishiganga and Dhauliganga valleys in the Chamoli district of Uttarakhand were impacted by a catastrophic flood triggered due to a massive rockslide. The huge detached mass of rock and ice caused rapid fluidization, created massive water/slush waves and washed away partially or completely the hydel power projects in its route (Pandey and Chauhan et al., 2021). Damming of Rishiganga River due to the detachment of a sizeable rock mass and overlying hanging glacier in the Raunthi catchment caused devastation in the downstream (Sain, Kumar and Mehta et al., 2021). According to Rana, (Shubhra and Sundriyal et al., 2021) the flash flood was triggered by a combination of avalanche and debris flow. They further argued that obstructing the free flow path of rivers in paraglacial zones is going to have an amplified impact on the life and infrastructures in the Himalaya.

Natural disasters in Himalaya are being attributed to geodynamic complexity, active seismicity, extreme climatic events, fragile rocks, critical hill slopes of this region and the global warming (Valdiya, 1998 & 2001; Bajracharya et al., 2009; Naithani and Nawani, 2009; Uniyal, 2013 & 2016; Verma, Prasad and Uniyal, 2017; Dubey and Shukla et al., 2013; Hoegh-Guldberg, Jacob and Taylor et al., 2018). Earlier Naithani & Nawani (2009) reported high probability of planar and wedge failures in dry slopes and those of subsidence and creeps on wet and dripping zones in the lower catchment of River Dhauli Ganga. This is a possibility which may now be investigated by researchers in the upper catchment of Dhauli Ganga (that covers Rishiganga River as well) along with the other plausible causes. Further, the sequence of events and process mechanism of Rishiganga tragedy was unraveled by (Pandey and Chauhan et al., 2021), through multi-temporal satellite image analysis, aerial survey, seismological data in conjunction with geo-spatial and geo-visualization tools.

Rishiganga disaster in fact raises the second alarm for a number of valleys of Higher Himalayan region. It was Kedarnath tragedy during the summers of 2013 that had raised the first alarm (Dobhal et al., 2013; Uniyal, 2013). For quite some time, we have become habituated to look deep into the causes for such disasters only after they happen. We need to accept this harsh reality with utmost respect for the scientists, engineers and researchers who are tirelessly working in the Himalayan hinterlands. The bits and pieces of information on earlier disasters and sequence of events as recreated by Himalayan researchers are still not being put together to create an integrated disaster forewarning mechanism.

2. Himalayan Hinterlands: Beautiful but Treacherous

Himalaya is too beautiful to look at and equally adventurous but at the same time the lofty mountains, narrow valleys, critical hill slopes, hostile weather and high altitude make it one of the toughest places to work. Labourers, engineers and geologists staying in tin shades in the narrow treacherous Himalayan valleys by the side of a torrent deserve a thumbs-up. Since, they have their lives at stake while working on a hill road or tunnel of a dam. In the post disaster scenario of Rishiganga Tragedy (also referred to as Joshimath tragedy due to the proximity of the disaster site to Joshimath town of Chamoli district of Uttarakhand), our instantaneous reaction will be to comment on the negative aspects of construction of dams and hill roads in fragile Himalaya. Over the past couple of decades or so, particularly after Okhimath and Malpa tragedy of Uttarakhand Himalaya in August 1998, there have been number of deliberations. The recommendations of most of these deliberations call for avoidance of rigorous construction of hill roads and other infra and hydropower projects in this region.

After Kedarnath tragedy of 2013, the causative factors were elaborated in detail by a number of researchers with many of them calling for strict adherence to the norms of environmental conservation. Further, a new debate was initiated on whether or not shall there be new mega-infrastructure and hydropower projects in Himalaya.

It is easy to blame planners for the ill-conceived construction of roads, dams, tunnels, powerhouses and buildings in eco-sensitive and fragile terrain of Himalaya. However, it is quite difficult to provide an alternate model of development for eco-sensitive and strategically significant hinterlands of Himalaya nestling in the natural beauty.

When we advocate ban on construction of infra and hydropower projects in Himalaya, we must not ignore two important challenges, the first being the well known challenge of economic and social development in these hinterlands. The other one is the strategic challenge that calls for development of roads, communication and power infrastructure at a rapid pace. This is a well known fact that during past six decades or so, it is not only the economic development of Himalaya where we have been lagging behind but even the strategic initiative in terms of border infrastructure development has been lost. Much of this can be attributed to the sluggish pace of our infra development projects, which have otherwise been entangled in the long loops of planning. Long wait for environmental clearances, slow pace of construction owing to economic constrains and also the ill planned rehabilitation has delayed the projects. However, during past decade or so the infrastructure development in this region has picked up pace.

Rehabilitation of the populace affected due to the construction of infra and hydroelectric projects in Himalayan region has been an important and sensitive issue. Long duration of time ranging from few years to many decades in the rehabilitation of the affected community has taken toll of many developmental projects and also caused great inconvenience to the former. Loosing ancestral villages and beautiful crop fields with step cultivation and fruit trees has certainly been a trauma for the generation of locals who lost them to infra and hydropower projects. As a consequence, the picture of inclusive socio-economic development as painted by many could not become a reality in Himalayan region. To add worst to it, has been the frequent occurrence of landslides, extreme rainfall induced flash floods, glacial lake outburst floods (GLOFs), landslide lake outburst floods (LLOFs) and avalanches in this region (Allen et al., 2016; Uniyal, 2016). The question then arises, “Had the phenomena of global warming, climate change and increase in the frequency of disasters would not been there in Himalaya, if roads, bridges, dams and tunnels were not constructed ? The answer to this with a plausible logic could be that the instances of natural disasters could have been far less in such a scenario. The big question that haunts us is how do we move ahead with our infrastructure planning in the immediate aftermath of Rishiganga tragedy with scary memories of Kedarnath tragedy still afresh in our minds?

The dual challenge of economic development and strengthening strategic infrastructure in Himalaya certainly calls for unimpeded infra development in this region. But environmental degradation and increase in the frequency of disasters become the major impediments in it. What do we do then and what is the future course of action ? We have no option but to continue with the present pace of infra development in Himalayan region, otherwise, in the coming decades, we may find it difficult to stop the migration of local populace. Consequently, many of the Himalayan valleys might be abandoned in the coming decades. During 20th century the lack of development, slow pace of rural to urban transformation and fewer employment opportunities have been the main reasons for the population migration from this region. In recent years catastrophobia has become a major reason for migration from some of the Himalayan valleys. Large scale migration from Mandakini valley (also referred to as Kedar Valley) in the aftermath of Kedarnath tragedy of 2013 is a noteworthy example. This calls for a multifaceted approach wherein the development initiative goes hand in hand with the disaster containment. Such an approach shall be aimed at the unimpeded infra development in Himalaya with elements of disaster resilience imbedded in the planning stage itself. Roads in and around towns and villages, expansion of railways and construction of new dams with elements of disaster resilience are need of the hour. Furthermore, the infrastructure and power sector projects don't always invite greater disasters, contrarily in some cases they even enhance resilience to the impact of disasters. Since the dams have the capacity to impound the large amount of flood waters of their upper catchment areas. A modelling framework was proposed by Boulange, Hanasaki, and Yamazaki et al. (2021) for the first global assessment of the role of dams in reducing future flood risk. Their modelling framework quantifies changes in the frequency of historical 100-year return period floods when dams are considered and estimates the global population at a reduced risk of flood exposure. A series of small dams could structurally mitigate floods to a great extent in Himalaya, particularly in the downstream populated areas having infrastructure and business activity.

3. Some Action Points for Developing Disaster Resilience

Need for incorporating the component of disaster risk assessment in our developmental planning has been advocated by some workers in the aftermath of Rishiganga tragedy (Rana, Shubhra and Sundriyal et al., 2021). There seems to be a dire need for taking up some important R&D and infrastructure planning initiatives for recalibrating our ongoing and future infra and hydroelectric projects. Some of the urgently required initiatives aimed at timely forewarning and mitigation of disasters and selection of safer sites for new constructions are elaborated below:

i. Near real to real time monitoring of emerging GLOF/LLOF and or slope instability scenarios in Himalayan valleys through conjunctive use of geospatial technologies such as series of high resolution earth observation satellites with high temporal resolution, aerial LiDAR, UAVs/Drones, GPS surveys and GIS based Decision Support System.
ii. Creation of digital terrain and flood forecast models showing simulation of cloudburst and landslide induced flash floods, GLOFs and LLOFs for hazardous valleys. This should be coupled with the demarcation of the extent of lower, middle and upper hill slopes of Himalayan valleys prone to GLOF, LLOF and or flood hazard.
iii. Installation of automated weather monitoring stations, sensors and instruments to monitor incessant rains, slope failures and avalanches in all the risk prone Himalayan valleys.
iv. Use of the new innovative ways such as sensor fusion and machine learning for automatic creation and time to time upgradation of multi-risk models. Such risk models should be area specific, workable and actionable and not just the demonstrative one meant for visualization only.
v. Establishment of an 'Integrated Centralized Disaster Forewarning System (ICDFS)' for Himalaya should be the first step forward towards developing effective resilience. This ICDFC shall be connected to the field data collection sites through wide area network (WAN). Further, it should have a robust system for real time data reception from field sensors, instruments, UAVs and earth observation satellites. Equipped with data storage, analysis and transmission facilities the proposed ICDFS will gather the bits and pieces of information from vulnerable areas and process them to infer the incubating disaster. Finally, it will disseminate the warning among the vulnerable community and the first responders in real time.
vi. The above proposed Integrated Centralized Disaster Forewarning System (ICDFS) will have to be strengthened through conglomeration of smart technologies for

mass data collection from a number of hazardous areas. Further, it should have interconnected intelligent systems and also the capability of data sinking and real time processing of huge volumes of data. Cutting edge techniques such as cloud computing and data mining should also employed for real time processing of data and dissemination of warnings.

vii. Since the available time for evacuation from the probable disaster site/sites in the event of a flash flood or debris flow would be a few minutes or even less. Hence, there must be forewarning systems and SOPs in place for the construction workers and the local and floating populace for the safe evacuation within a very short span of time.

viii. Action on point number 'v' above should be supplemented by real time crowd sourcing involving shepherds and local villagers of Himalayan valleys for getting information from them about the signs of an impending disaster. In order to make them an integral part of disaster resilience framework the shepherds and local villagers of risk prone Himalayan valleys can be provided mobile phones. Further, their capacity building sessions shall also be organized, so that they can inculcate their interest in reading the signs of an incubating disaster.

ix. A system of cash rewards for locals and shepherds can also be put into place for timely forewarning about the signs of large scale slope instability or natural damming of rivers in Himalayan hinterlands. The signs of large scale slope instability can vary from emergence of large cracks, sudden widening of existing cracks in the upper reaches of hill slope to subsidence of road, foot/mule track and tilting of trees and poles etc.

x. There is also a need for integration of traditional and also the earlier systems of disaster forewarning practices with the modern technical know-how. This can help in adopting a holistic and community friendly approach towards disaster management in Himalaya. The age old traditional practices of hill drainage (danada cool in local parlance) system for mitigation of landslides and the early warning communication some 125 years ago in 1894 have been researched by some workers (Rautela, 2015; Demri, 2013). The age old whistle blowing practices for forewarning of flood disasters were also prevalent in some areas of Uttarakhand Himalaya.

xi. A well defined mechanism for the disposal of slope cut debris with dedicated sites for dumping of muck or its optimal utilization as the construction material for the existing project and also the afforestation measures should be in place for slope stabilization and amelioration of the local environment.

xii. More and more use of cut and fill method for road construction, gradual replacement of diesel driven shovels by electric shovels are some eco-friendly measures that can be adopted in the construction of new infrastructure and hydel projects, so as to mitigate to some extent the risk of frequent slope failures in new and/or recently widened route corridors.

xiii. Faster mechanization of construction activity in Himalayan valleys will enhance the resilience of construction workers and engineers of infra and hydroelectric projects in this region. Innovative ways such as introduction of robotic arms and remote controlled shovels can help reduce the risk posed to human lives involved in the construction activity in the areas of flood and/or landslide risk.

xiv. According to the BMTPC (2005), a major part of this region falls in the Earthquake Very High Damage Risk Zone V. Hence, there is a dire need for planning the new settlements and infrastructure with earthquake resistant design as a precondition.

xv. In order to enhance the resilience of the new infrastructure to multi-hazards, a long term action plan should be in place. Any such plan shall include gradual shifting of business and housing facilities to the upper hill slopes, which are beyond the limit of high floods and at the same time don't fall in the critical zones of landslide hazard. However, there can be exceptions in case of strategic infrastructure projects and or the tunnels of hydroelectric projects. Because there might not be any scope for taking the alignments of such projects to upper hill slopes.

xvi. Strict adherence to landuse regulations should be ensured and new provisions for tax incentives and other financial incentives are required for encouraging planned shifting of the existing commercial areas falling in the unsafe zones. This will encourage new business opportunities along the landslide and flood safe segments of hill roads and drastically reduce the number of elements at risk.

xvii. The paucity of funds for a robust infrastructure of disaster forewarning can be dealt with by modifying the clauses of the competitive bids of major infra and hydroelectric projects. It can be made mandatory for the bidders to contribute for disaster forewarning infrastructure including installation of sensors and instruments in and around the area of the project, if they get the contract.

All the above suggested measures from point 'i' to 'xvii' might not prevent Himalayan hazards, but could certainly enhance the resilience which in turn can drastically reduce the fatalities during such events.

4. Some Noteworthy Examples of Mountain Infrastructure Development in the Alps

Switzerland is the best example which has developed connectivity to the snowy mountains of Jungfrau, rocky ridge of Gornergrat and the summit of Brienzer Rothorn and ameliorated their environment as well. Had Switzerland not developed railway infrastructure on its beautiful snow clad mountains just out of the fear of environmental degradation and onslaught of disasters, it would not have emerged as a leading tourist destination in the world. India too can offer tourist facilities in Himalaya matching those with Switzerland by developing mountain infrastructure. This in turn will greatly contribute to the economic and social development of Himalayan hinterlands and will also give us a great strategic strength on our northern frontiers in terms of border infrastructure. However, developing an infrastructure in Himalaya similar to Alps is constrained by geodynamic complexity, active seismicity, extreme climatic events and fragile hill slopes. Further, the high vulnerability of many settlements and above all the huge economic cost of projects are some of the major hindrances in creation and sustainable management of infrastructure such as mountain railways in Himalaya.

5. Conclusion

How long would we continue to oppose infrastructure development in Himalaya by citing earthquake high damage risk zones V and IV, high to severe landslide and flood hazard zones and occurrences of extreme climatic events in this region? Are these multi-hazard prone, strategically significant Himalayan hinterlands nestling in the natural beauty destined to remain backward for these obvious reasons? Can we every time impede infrastructure development in this region by citing the Gauna Lake Outburst of 1894 and Madhyamaheshwar Lake formation in 1998? However, we can certainly avoid constructing roads on every bits and pieces of Himalayan mountains, so as to avoid the immediate surge in floating population during pilgrimage season. But to out rightly reject the idea of connectivity crisscross, combo of rail road network and series of small and medium dams in this region is not only a development blunder but it will also amount to strategic hara-kiri in the long run.

Rather than initiating a debate on stopping infrastructure and hydroelectric projects, it is the reduction in vulnerability that is key to disaster mitigation in Himalaya. As discussed above an Integrated Centralized Disaster Forewarning System (ICDFS) can be a crucial component for enhancing resilience of the vulnerable population including those of construction workers and the local populace.

Our strategy for Himalaya should not be centered around the concept of long loops of environmental clearances and termination or non-initiation and or delays in infrastructure projects. It should in fact be aimed at greater access and connectivity to the Himalayan hinterlands through safer roads, railways, communication network, uninterrupted power supply lines with elements of river management and disaster resilience embedded in these projects.

(The views expressed in this article are those of the author and do not reflect the views of any organization and or institution)

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