Infrastructure development in the Himalayas

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Introduction

Over the past two centuries, the Himalayan natural landscape has seen man trying to conquer it with roads, electricity, communication, as technology takes quantum leaps to triumph over the vagaries of nature. But the pertinent question that arises is that are we doing justice to the ecology of this invaluable geological and bio-diverse region?

Infrastructure has been defined as "*the basic physical and organizational structures and facilities needed for the operation of a society or enterprise*." It is a simple enough definition for most areas, implying the building of roads, the laying down of electric cables, the construction of bridges and more such activities. But the word acquires a different meaning when applied to the mountains, especially the high altitude areas. Issues like ecology, biodiversity and climate change assume grave importance and present multi-faceted problems to the building of these basic amenities.

Difficult terrain…less developed…little understood

The high altitude Himalayan regions, with which we are concerned here, present a number of difficulties to the development of infrastructure. These areas, for the most part, are harsh expanses of wasteland and craggy slopes surrounded by snow-clad peaks. The communities living in these areas lead a far from easy life, eking out a living from subsistence agriculture during the short, mild summers; the winters are bitter stretches when no productive activity is possible. Temperatures rarely go above 17 °C in summer and plummet to as low as -40°C in winter. 89% of the population works on their own fields and markets are hundreds of kilometers away. The extent and quality of infrastructure and basic services—considered commonplace in the plains—is poor. The developmental status of these communities is therefore far below than that of the rest of India.

The geographical area of the high altitude Himalayas in India spans in a curve across the northern and northeastern boundary of the nation including the districts of Leh and Kargil in Jammu and Kashmir, Lahaul & Spiti and Kinnaur in Himachal Pradesh, Chamoli, Uttarkashi and Pitthoragarh in Uttarakhand, North and West Sikkim in Sikkim and Tawang and West Kameng in Arunachal Pradesh. Economically

backward and remote, these areas are dotted with small villages at altitudes between 2600 and 5300 metres.

Need for Himalaya-specific development

It is in these overwhelming conditions that the government, the local communities, NGOs, and other stakeholders are trying to set off a process of development. In some aspects, a degree of success has been achieved, like bringing connectivity to the isolated mountain areas through roads and communication services and taking conventional energy resources to many of the remote villages. But these achievements have been marred by the disturbance that they have caused to the ecology and the homogenization they are imposing on local cultures. Much more still needs to be done to raise the living standards of these marginalized communities residing in these regions, while taking care not to further harm the ecology.

In this paper, we will try to highlight the most pressing issues concerning infrastructure development in the high altitude Himalayas, with a special focus on the communities and the ecology of the region. These issues have been culled from the years of experience of the scholars, scientists, researchers, community workers, and the like working in/belonging to these regions. While the debate on these issues will continue for some time to come, this paper simply intends to throw some light on basic realities and take a holistic perspective to offer solutions.

Review of Initiatives

Connectivity

Status, Need & Gaps

Transportation is considered to be crucial for overall regional development as without physical access to employment, health, education, and other amenities, the quality of life suffers and without proper access to resources and markets, regional growth stagnates. The high mountain ranges are perhaps one of the most difficult terrain that man has set out to conquer. But nowhere is the enormous effort towards infrastructural development more visible than in the building of roads in the high Himalayan areas. In India, the task of connecting the mountain regions to the more developed and well connected plains falls in the hands of governmental organizations like the Border Roads Organization (BRO) and the Public Works Department (PWD). There has been intensive road building in the high altitude Himalayan areas over the last few decades, resulting in the building of some of the highest motorable roads in the world. The high altitude areas are connected by road like never before, due to these efforts. But remote areas of

the high altitude regions still remain inaccessible. Village called Pakchuk, where roads cease to exist at all. The locals in West Sikkim repeatedly mention a

Road density (road length per 100 sq. km) in the West Kameng district of Arunachal Pradesh is still 23.23 and only 30% of the roads in the neighbouring Tawang are metalled. 46% of the villages are more than 10 kms away from the closest bus stop. (Arunachal Pradesh HDR, 2005). Tawang however, fares better than Lahaul & Spiti of Himachal Pradesh, where a meager 2.52 Km of road qualifies as a '*pucca*' road, for every 100 km against the all-India average of 82 km per 100 km. The State HDR for Himachal Pradesh mentions that most of the roads connecting small villages in the state are not all-weather roads. Loose soil strata can hardly sustain rains, frequent slips, and snow make these roads usable only for a limited period. While the low lying cities of Uttarakhand are accessible throughout the year by road and rail, the villages in higher altitudes remain cut off for large periods in a year due to snowfall (Task Force, 2010). Road densities of J&K, Arunachal Pradesh, and Sikkim are among of the lowest in the country and fall way below India's average of 106.

Block Nawagaon in Uttarakashi District has a number of villages where there is no road connectivity. 19 such villages have been reported in a PRA with the maximum distance to a rail/road head being 5kms (2.5 hours). The farthest village from block headquarter is the village from Nawgaon Godra, 6-7 hours away. In the same district lies the block of Purola, Locals tell us of an area by the name of Sar Badiyar covering 4-5 villages. Situated at North from Purola, it does not have any road connectivity, the nearest rail/road head being a tiresome 20 kms away.

Winters often prove to be a tough time for the locals with many roads cut-off. While transoport availability on the NHs is easier and more frequent, this seems to take a backseat in the winter season. In Block Purola (Uttarkashi distt), on the Karda village side the road is closed for 3-4 days while in Sarbadiyaar for 20-25 days during winters. In West Sikkim the Kechhipury-Deonali road gets blocked in Monsoon every year, according to the locals inhabiting nearby villages.In village Lungshuganj, public transport is poor and roads don't exists either, as a result of which old and young alike, need to trek long distances to reach main roads. According to the locals, this creates a massive problem for patients to access hospitals, children to attend school and markets to buy ration and other supplies. Natural disasters like landslides were seen as a major cause of hampering transport services, thereby increasing prices of their goods.

But it needs to be admitted that there has been a considerable effort to improve the status of connectivity in India's Himalayan border regions, as all-weather transport routes are strategically important for the Indian Government for defense and economic reasons. So, despite the difficulties imposed in road construction, there has been a significant improvement in road connectivity in the region over the past few

decades. For instance, in the last 60 years, Himachal Pradesh has seen a phenomenal increase in the length of road network with continued efforts of the government. The State's surface road density of 8.5 km per one lakh population that was the lowest in India in 1951 is now 454 km per one lakh population. According to the PWD estimates, 80% of the road network in Himachal caters to the rural population and 60% of the villages are connected by roads (Sarkar, 2010). Interactions with the local community during a study (Sarkar, 2010) revealed that the National Highway 22 in Kinnaur has boosted horticulture development by facilitating the transportation of apples to major wholesale market centers all over India. The study indicates that as roads provide potential for augmenting cash sources of income, the local inhabitants prefer to live within the region instead of migrating.

Environmental & social repercussions of road construction

Though better connectivity had made life easy for the Himalayan people in many ways, the rampant road construction has taken its toll on the delicately balanced systems in the region also affecting ecosystem services such as fodder, fuelwood and fresh water. For instance, the construction of the Rohtang Tunnel, more than 3000 meters above sea level in the Western Himalayas is a landmark project taken up by the government. It is supposed to shorten travelling distance to Lahaul and play an important role in defense supplies to the strategic border areas. But the ecology of the Himalayan region will have to pay heavy price for this ambitious project. Though widespread studies by experts from several agencies like National Hydro Power Corporation, Geological Survey of India, RITES India Limited, Snow and Avalanche Study Establishment and Konkan Railways have been conducted to make sure ecological balance does not take place, the fragile ecosystem is sure to be affected. More than 700 spruce and walnut species trees will be cut down for the tunnel construction and the explosives used will upset the ecology. One of the major concerns of the Forest department is the dumping of muck. Already the region is facing natural disasters like cloud bursts and flash floods and with the construction of the tunnel the situation is bound to worsen.

The muck thrown by the hillside during road construction projects clogs and contaminates the springs- the main source of irrigation and drinking water for the communities. The debris creates artificial water channels and destroys the green cover of the mountains. At places, the destruction of forest and diversion of water affects the local climate to the extent that farmers are forced to change cropping patterns (Shrivastava, 2006). Dr. V.K. Madhavan, director of CHIRAG (Central Himalayan Rural Action Group), an NGO that has been working for the sustainable development in the Kumaon region of India's Central Himalayas, says *"there has been significant investment in roads, but it has affected natural drainage and now we are starting to see the impact of these roads mushrooming all over the place on recharge of springs"*. It is a concern that has been raised more frequently over the last decade, with natural springs drying up and water scarcity becoming a huge issue in the Himalayas. Women in

Himalayan villages have to trek greater distances in search of water and it is becoming increasingly difficult for farmers to irrigate fields in the summer. “Water stress” is the buzzword these days in circles that are discussing the impacts of climate change in the Himalayas, but not many are aware of the contribution that unplanned development is making to the scarcity of water already being felt across Himalayan regions. Dr. Madhavan goes on to suggest, “*The importance of roads cannot be denied as they aid transportation of commodities to the markets and movement of ambulances. But it should not be difficult to do a simple environmental assessment of the roads with respect to the natural drainage to ensure there are adequate culverts in the areas and drainage is not affected.”* Besides positive responses from some locals also correspond to the fact that there has been an improvement in road connectivity, though slightly. Mr.Dendup Bhutia from the Highlander Guides and Porters Welfare Association said, when asked about how access to services is hampered, says “though deaths due to untimely reach of medical facilities were commonplace earlier, it was not the case now.”

Widespread road construction has also lent more frequency and ferocity to a common natural occurrence in high altitude regions – landslides. It has been estimated that in the Indian Himalayas, for each linear kilometer of mountain road, nearly 10 small to medium landslides occur as a result of slope instability caused by the road (Sarkar, 2010). The regular blasting of the mountain ranges accompanied by felling of trees leads to loosening of the soil and rocks on the slopes, giving rise to the ever present danger of this calamity that can assume bigger proportions during bad weather. Frequent damages to poorly designed roads also undermine the high degree of capital infusion invested for laying mountain roads, that can vary between Rs 50 lakh to Rs 1 crore per km of road constructed (Sarkar, 2010). Mr. Chetan Singh, the District Vice President of the Himachal Gyan Vigyan Samiti, Lahaul says, *“Earlier the road construction used to be manual, but now heavy machinery is employed which disturbs the soil and makes it more prone to landslides. To minimize the risk of such events, the road construction authorities should consult the local people and carry out the construction work in appropriate seasons.”* The need of the hour is to find the balance between developmental activities and conservation.

Need for a sustainable approach

Academic studies undertaken in the region have reiterated that road construction in the Himalayas has been widely pursued disregarding geomorphologic constraints that characterize the region (Sarkar, 2010). In view of the socio-economic considerations, a sustainable approach to road construction would imply moving a step forward beyond developing only basic infrastructure. A sustainable road project is the one which “*aims to reduce the rural poverty in the rural areas by extending the network of rural transport infrastructure and more importantly provide employment to the community, empower them, increase the institutional capacity building and improve the sense of accountability and transparency”* (Mulmi, 2009).

The ‘green roads’ adopt an environment friendly approach and utilize the various soil bioengineering techniques to ensure stability of slope and control of the erosion, promote the optimum utilization of local construction materials (making it more cost-effective) and local people participation in each stage of the project.

Wherever possible, sustainable means of transport such as ropeways must be installed as an effective alternative to rural link roads; such measures will need to be articulated effectively to the local community by highlighting the environmental benefits (Sarkar, 2010). The environment friendly and financially viable gravity ropeways can create improved market linkages and a easy mode of transportation for the goods. Dr. Anil Joshi, the founder of HESCO, says, *“Unfortunately, we never think of other transportation modes other than roads. In many cases, airplanes and ropeways are also an important mode of transportation.”* Mr. Chetan Singh who has traveled extensively across the High-Himalayan belt, comments that *“while Ladakh is well connected by air, Arunachal Pradesh in the far-east faces problems in air transportation for six months in a year due to the unfavorable weather”*. Mr. Min Bahadur Shahi, the Chairperson of KIRDARC, an NGO operational in Nepal’s Karnali zone since 1999 also opines *“in the context of infrastructure, air service among other services is very important. Another issue needing particular attention in the mountain context is bridge construction.”*

It is an idea that experts are hoping will take root in the psyche of the authorities as soon as possible – not applying generic definitions of connectivity infrastructure to the high altitude Himalayan areas, but adapting to the needs of the local people and the environment.

Information and communication technologies (ICTs) like telephones, satellite phones, internet connectivity and radios can also play an important role in providing the remote and vulnerable communities in the Himalayan region access to new information along with opportunity for sharing and creation of knowledge.

Except for the reach and penetration of mobile phones and service providers, the conditions of most communication services is dismal. Locals in Purola said they hardly listened to the radio anymore, and were unaware of radio broadcast timings. Instead, FM was gaining popularity, but signals varied according to the area they were in. Newspapers were available from nearby districts but national dailies were out-of reach.. Local newspapers like Himali and Telepgraph are available in most parts of West Sikkim whereas magazine subscriptions are rare but available in West Sikkim. The popularity of mobile phones as a medium for communication is evident with a multiple number of service providers. However, quality of service/signal varies from place to place. According to locals, Jongri in West Sikkim did not have connectivity, and 50% villages in Purola Block have poor mobile connectivity. Residents of Maneybhanjang and Dhotre, in Darjeeling are not privileged in this aspect. Poor connectivity keeps them

disconnected from others in the region. Locals reiterate the fact that while private as well as public service providers exist, the connectivity and quality of services is either average or poor. WLL/satellite phones too have not been a boon to the locals. WLL according to most is a thing of the past. In Nawagaon Block, 15-20 villages do have WLL connection, but are no more in use. Locals in Barkot say that the functioning of WLL depends on battery back-up, thus making it an impractical medium. For most locals, the advent of mobile phones has proven to a better option over satellite phones and WLLs. However, where the reach of mobile phones is poor, these are the only two mediums that can be utilized, in particular during emergency services.

Internet connectivity ensures that locals have access to a vast platform of knowledge as also communicate with people around the world at low costs. But for most locals, this has remained a partial dream. While accessibility exists in most areas, poor quality and steep prices prevent wide-scale usgae of the medium. Barkot, Damta and Uttarkashi in Uttarkashi have access to internet by BSNL,, but connection, they complain, is not reliable.

This can aid in broadening the already available resources (informational and economic) in the region, awareness creation and in helping to strengthen the decision making processes of the vulnerable communities. The access to better resources through the can not only strengthen the local livelihoods (e.g. through availability of online training programs for farmers, technical skills, facilitation access to wider markets, income diversification and expert advices on improving crop productivity), but also help in capacity building of the region.

Energy - *Status & Need*

Energy is neither explicitly recognized as a basic human need nor as a cause of poverty. Yet it is clear that efficient and uninterrupted supply of energy facilitates the forces of development, enables a better quality of life, and builds human capacity. Paucity of energy remains one of the key bottlenecks for the development of the high-altitude Himalayas. About 5000 villages in the region are still not electrified and people have to rely completely on fuelwood for heating and cooking. Biomass, with its severe environmental and health costs, is the major fuel, of which 60–80% is in the form of fuel wood. Firewood remains the primary source of cooking for a majority of households (4.31 million; 66.0%) in the Indian Himalayan region. Among other kitchen fuels, LPG is used most widely for cooking (1.58 million households; 23.7%) followed by kerosene (4.6%), cow dung cake (3.6%) and crop residue (2.1%). This implies a general lack of access to clean energy sources and dependency on biomass-based fuel to a larger extent in the region.

Traditional knowledge for managing the energy issue is also eroding with time. For instance, the recent

microclimatic changes in the Western Himalayas have affected the stability of the mud buildings designed to provide insulation and are forcing people to shift to other building materials. Commenting on the housing infrastructure in Uttarakhand, Dr. Joshi goes on to add *"earlier we had houses that were built of wood, which was locally available and now energy-intensive materials like bricks are transported from plains to the mountains imposing more pressure and involving greater transportation costs."*

With the increasing number of hydropower projects being undertaken in the Himalayan region, the electricity coverage of villages in the region has also shown a significant improvement. As evident from table 3, leaving Arunachal Pradesh, all Himalayan States have achieved over 90% coverage in rural electrification. Though coverage has improved significantly, the quality of supply still remains very poor. The power outages are high. Electricity is available for an average of about 40 per cent of the time. The residents of Purola Block in Uttarkashi echo these sentiments. The best electricity supply they receive is that of 20 hours per day, and the worst being 10 hours. In case of damage to equipment, restoration of electricity supply takes 4-5 days while in the more remote villages, 15-20 days.

The poor quality negates the benefits of connection by lowering efficiency disrupting schedules and damaging electrical equipment (Sharma & Bhardwaj, 2007). Low voltage is a common complain during the winter season. Electrical equipment, like TV and lights get hampered due to voltage fluctuations. For the poor in these areas, it means additional expenditure on fixing or replacing equipment, while nothing has been done to tackle these fluctuations, they complain. The transmission and distribution losses in Uttarakhand amounting to 39% are well above the national average (Uttarakhand Vision 2022).

Many agencies are involved in addressing the energy needs and demands of the High Altitude regions. Among these is The Uttarakhand Renewable Energy Development Agency (UREDA) that works at districts levels to promote renewable energy sources for electrification in line with the guidance of Ministry of New and Renewable Energy and the conductive platform for the promotion of energy conservation. But in many blocks such as Chinyalisaur, responses of the locals to subsidies provided by UREDA were not encouraging. Upto 80% subsidies on the utilization of renewable energy appliance's could be availed but it was reported as a time consuming activity and unfruitful activity.

LEDeG, an NGO working based at Leh, with support from LAHDC, ICEF and MNRE has setup a solar photovoltaic power plant at Tangtse which has replaced the 250 kVa diesel generator of the Power Development Department of the government. The plant provides electricity to more than 350 households in the region for 5 hours a day. In another of their project, implemented in cooperation with several other NGOs in the Western Himalayas, they are working on passive solar housing, the aim of which is to improve the living conditions of the communities there.

The key issues

The existing energy infrastructure in the Himalayas with a severe paucity of clean energy sources has various environmental, financial, and social implications.

Economic implications: Winter activities like handicrafts, carpentry etc. that require heated space have suffered terribly in these regions due to the growing energy shortage. Crop residues burnt, as cooking fuel is a loss of valuable agricultural biomass that can be used as fodder or manure. The inadequacy of power in the region is a critical factor in the region's continued underdeveloped state. The economy remains completely subsistent and no economic diversification into alternate livelihoods has been possible. As a region dependent on primary activity, large-scale agriculture cannot be explored without the advent of agricultural machinery. In most regions like Uttarkashi and Darjeeling, the locals said there was no consumption of energy in any processing mills or storage chambers. This is a limiting factor for the growth of local economy, which if developed, would be dependent on these energy-consuming activities. However the provision for energy supply could be made via the availability of renewable energy sources.

Environmental implications: The limited green cover is being considerably depleted due to collection of shrubs for fuelwood requirements. Overuse of firewood is also leading to environmental imbalances like soil erosion and changing trends of snowfall.

Social implications: Women's health is affected by exposure to wood smoke and the carrying of fuelwood loads on their heads across long distances. The decreasing fuelwood availability has shrunk the energy available leaving the region's quality of life under stress. The lack of energy supply in schools undermines attendance of students. The locals of Chinyalisaur Block in Uttarkashi district narrate the unfortunate story of the Chinyaligaon School, where for the past one year there has been no electricity. Computers have been unused. A similar story comes from Purola Block in the same district. A mere 50-60 schools have electricity supply. Heating systems are also absent in these schools, dissuading students to step out in the initial winter months. Heating supply to schools and PHCs would enable people to ensure better services, according to some villagers.

Irregular & inequitable supply**:** The supply of energy in the Himalayas is again a highly debated issue, where once again the usual infrastructural battle to draw electricity lines across the length and breadth of the mountains draws flak for its invasive nature. Dr. Anil Joshi, who has worked extensively in the area of sustainable energy projects for high altitude regions says, *"Any energy intensive initiative for infrastructure is unfortunately never pro Himalayas, they are against the Himalayas' fragility."* Though one

sees electric wires crossing the skies at altitudes up to even 4000 metres today, the question to be addressed here, is whether the infrastructure is serving the purpose of providing a basic amenity to the local population. Though most areas have been electrified, the quality of the energy available is by no means satisfactory, with blackouts being the norm, especially during winters.

The untapped potential of renewables

Realizing the problems of the Himalayan region, renewable energy sources like sun, wind, and water would be the best replacements for the conventional energy sources to improve the quality of life of the indigenous communities. The Himalayan region is best suited for solar energy options because of a large number of sunny days. The Western Himalayan cold deserts, for example have around 8 sunshine hours per day almost round the year and 325 sunny days per year.

However, in spite of the huge potential, solar energy is used only on a limited scale in different Himalayan states (1.9% households in Uttarakhand and barely 0.7% in J&K) (Task Force 2010). Respondents from the Village Barkot in Nawagaon Block said maybe a mere 1% would be tapping into renewable enrgy resource. People of Sarbadiyaar and Kamrasankha Villages, in the Purola Block are harnessing solar energy whereas in Maneybhanjang, locals are using solar lights when there is no electricity supply.

That alternative energy resources are the way forward for these regions is a general consensus. Senior scientist and faculty at the Jamia Hamdard University, Dr. Uppeandra Dhar opines *"there is unconventional energy resource in the high altitude in abundance, which we need to tap as much as we can. This is one area where not much has been done."*

Renewable energies, solar, micro hydro and wind can benefit the indigenous communities considerably by developing income generation opportunities through increased productivity and by creating new avenues. Installing bio-gas plants, introducing solar dryers for agro-processing, hydraulic pumps and other applications of renewable energy technologies and bioclimatic architecture offer the people not only a sustainable option for energy generation but a way out of poverty.

Another renewable source of energy which has not yet been tapped into is geothermal energy. The Himalayan region, lying on collision zone between two continental plates of India and Eurasia, has huge potential for geothermal energy. In fact, the Puga hot spring region in Ladakh lying in the northwestern Himalayan region has been acknowledged as one of the most promising geothermal regions in India with temperature which goes up to 240°C. Although this non-conventional energy source has an estimated potential of around 10000 MW (Ravi Shankar, 1996), it is not even included in the list of non-conventional energy sources which can be exploited to address the power shortage facing the country, especially the

Himalayan regions.

In the present day main source of electricity generation in Himalayan region is majorly diesel or hydro-based. According to studies conducted in the Ladakh region in 2005, more than 7000 liters of diesel is required everyday for heating and lighting purposed. Also majority of the villages in extremely remote areas of the region are still dependent on kerosene. However, these energy sources have certain limitations and during the harsh winters even hydro power is unavailable in the region. Compared to this geothermal energy has huge potential, especially in the Himalayan region and small-scale projects of even 5 KW can bring about significant economic and livelihood situation changes of the communities there. However, in spite of its potential and round the year availability, geothermal energy is not on the priority list of the government.

Hydropower in the Himalayas- pros & cons

Though there have been a number of attempts to create a reliable infrastructure to tap solar and wind energy by various bodies, the government's priority seems to be to harness the many water resources of the area, through micro hydro-power plants. As has happened to large-scale river based energy initiatives elsewhere in the country, these projects too are facing opposition from the community at many sites. Dr. Joshi says, *"There are many other options but the government is putting in efforts in micro-hydropower while the activists are opposing it. Unfortunately, there has been no common solution."* In the same vein, Mr. Chetan Singh from Lahaul goes on to say, *"The community is strictly opposing the 400 MW project in Jispa. The authorities cannot proceed unless the Panchayat's NoC is granted."*

Hydropower dams in the Himalayas are being promoted as a solution to meet a substantial part of energy and electricity requirements. Energy starved India is increasingly depending upon the estimated 207,149 MW hydroelectric potential of Himalayan Rivers from J&K to Arunachal Pradesh. In Himachal Pradesh alone about 415 projects (over 300 small; 115 medium and large) are planned, under execution or operational (Shrivastava, 2007). However, due to the peculiar geographical and cultural circumstances, dams in the Himalayas are likely to have some serious social and environmental impacts in the region. Dam building can cause direct submergence of villages and can lead to huge losses of the resource base of the people residing on the riverbanks.

The various threats posed by dam building in the Himalayan region point to the need for a comprehensive review in each of the river basins in the Himalayas and call for evolving an alternative approach to meeting the pressing energy and water needs in a sustainable manner (Dharmadhikary, 2008). Some scientists have begun to feel that EIA studies alone are not enough to determine the real impact of big projects on Himalayan communities. A research (Agarwal, et al, 2010) suggests a 'Strategic

Environmental Assessment' in place of an EIA. In view of the same, the Task Force report also states that the cumulative impact of multiple hydropower projects along the same river basin calls for a region or entire basin-based SEA rather than individual project-oriented EIA that neglects the summation effect.

In view of tremendous damage capable of being caused due to hydro-power projects, the Task Force suggests that it is essential to demarcate zones in the higher Himalayan region that are naturally unstable and no hydropower projects should be allowed to be developed in those areas.

In particular, while these projects will generate many thousands of units of electricity, it does not imply that they will help improve access to power for the poor and vulnerable sections of society. In fact with the high cost of these projects, their long distances from load centers and privatization, they are likely to result in high costs of electricity not easily affordable by the poorer sections of the society (Dharmadhikary, 2008). The different settlement patterns also affect the cost of electricity supply to villages. For instance, the coverage of rural electrification in Arunachal Pradesh varies widely among the districts, from 100% in Tawang, to 34% in East Kameng as villages in Tawang have a cluster pattern of housing, which minimizes the cost of electrification (HDR, Arunachal Pradesh, 2005).

The basic problem seems to be that of the government going against the needs of the region, that call for a more decentralized approach. The dispersed nature of habitation in the region necessitates decentralized energy generation and distribution services. The lower capacity of the community, along with great homogeneity and cohesion, also calls for community level rather than household-level energy units. Pico- to micro-scale power generating systems using renewable sources at the particular site may be installed in a village and cater to all village-specific energy needs. These small projects also have a tremendous employment generation potential. A research (Sharma & Bhardwaj, 2007) points out that small hydropower projects developed as a vast network of mini electricity enterprises on a decentralized basis is the answer to the one of the most pressing issues of unemployment in the region and can provide a large number of jobs to people at their doorsteps.

NGOs like Center for Rural Technologies are coming up with low maintenance and cheap technologies for improving livelihood options and energy generation. The Improved Water Mill (IWM) technology is an improvement of the traditional mills. By replacing the wooded runner with an advanced metallic runner, the performance is boosted. Two types of IWMs are in place. The ones with a short shaft can only be used for grinding but the long shaft ones can also be used for other activities like paddy husking, lokta beating, saw-milling and chiuri expelling. The IWMs are not only important for agro-processing but depending on the availability of water resources, they can generate electricity of up to 5 kW which can be used for basic purposes like lighting, running televisions and operation of small cottage industries.

Tourism

One sector where the Himalayas have experienced exponential growth over the last couple of decades is 'tourism'. With increased connectivity and growing infrastructure, the number of tourists out to explore the beauty and mystique of the mountain range has grown by leaps and bounds. The year 2006 witnessed a growth of 17.8% in domestic tourists and 18.1% of foreign tourists over 2005 in the region. The states of Himachal Pradesh, Jammu & Kashmir, Meghalaya, and Sikkim accounted for over 98.5% of the total domestic and foreign tourist visits in 2006 (Task Force, 2010).

The concept of tourism in the mountains was introduced in India by the British, when they built up hill stations like Shimla, Dalhousie, Mussoorie, Dehradun etc., as summer retreats. But the high altitude Himalayas came within the reach of the avid traveler only after the 1962 Sino-Indian war, when the Indian army needed to access these far-flung areas through roads, for transportation of defence equipment and supplies. A good 10,000 kms of roads were built by 1970. The construction continues till date, with higher and higher altitudes coming into the reaches of adventurous tourists. With the primary issue of accessibility being addressed, the 'modern tourism' of mountaineering, hiking, river rafting, skiing, specialty resorts and the like started developing in these areas. And with this influx came the building of accompanying infrastructure, in the form of thousands of lodging premises, bigger markets, eateries, tens of thousands of taxis and so on.

The Impacts of Modern Tourism

While on one hand, these developments have helped tremendously in providing livelihood to mountain communities; on the other, they have driven a wedge into the sustainable living practices devised by the communities over centuries . There's total decay of most urban pockets particularly those en route to major destinations in the hills. A large proportion of the pollution is a direct consequence of tourist traffic and infrastructure built for tourists.

A very serious consequence of unplanned development is a looming drinking water crisis in the high altitude Himalayan regions. Dr. Madhavan points out that *"over the last decade, tourism has been promoted actively, which has led to a number of resorts and hotels coming up which require water for construction. The tourists flow in the peak summer season when water discharge is the lowest. Hence the locals find more and more natural springs drying up and have to walk longer distances to access drinking water*." He brings out the irony saying, "*People may have a television at home, but they have to walk twenty minutes everyday to find water.*"

Finding ways to assess and measure the impact of tourism and its associated development on sustainability is critical to developing long-term sustainability plans for the Indian Himalayas. Impact of unsustainable tourism on the Himalayan ecology has come to be a popular research topic. A study (Cole and Sinclair, 2002) indicates that the ecological footprint of Manali grew by over 4.5 times from 1971 to 1995. Another study (Geneletti & Dawa, 2009) devoted to assess the adverse environmental impacts of tourism and trekking-related activities in Ladakh concludes that the most affected watersheds are located along some of the most visited trails and within the Hemis and the Tsokar Tsomoriri National parks.

Green tourism: a concept gaining ground

Realizing the need of a more sustainable approach to development of tourism and associated infrastructure, 'green tourism' or 'eco-tourism' is now being promoted in a big way by the government and other hospitality providers. Ecotourism in the Himalayas is also being researched extensively as they are rich in ecological, recreational, educational, and scientific values, which need to be utilized in sustainable way. A research (Singh and Mishra, 2004) indicates that green tourism minimizes biophysical and human vulnerability and risks in mountain regions.

But the concept of green tourism is yet to achieve economic sustainability in the Himalayan regions on a large scale. As with most other problems regarding infrastructure in the regions, the answer lies with the community. Dr. Anil Joshi says, *"Everything should be made keeping in mind the local community, local resources, and the skill availability. When we promote tourism, which involves local skills and local resources it requires less infrastructure and is ecologically sound as well."* Mr. Shahi says, *"One has to keep in mind the negative impacts of tourism. We can do some advocacy at the government level and formulate policies for the tourism sector for the betterment of the community people".*

'Tourism vis-à-vis livelihoods' is also one area that is being studied to understand the vast potential of tourism in generating alternate livelihoods. Many research studies have provided insights into changes in livelihood strategies of the mountain communities over time. Researchers argue that ecotourism undertaken without local involvement is not desirable. Needs of the community and their ideas of conservation should be given prime importance. The tourist destinations will have to be developed in consonance with the local communities. Building low-cost infrastructure in the villages by using local materials and local design inputs will not only attract tourist but also create employment opportunities for the local people (Arunachal Pradesh, HDR-2005).

Financial Services

Financial services in the High Altitude Himalayan region are a glaring area where little research has been

done. A mix of both private as well as public sector banks as well cooperatives cater to the populations. According to the locals, SBI, HDFC, ICICI, AXIS Bank, and state banks are the most popular ones.

In West Sikkim, Geyzing and Yoksum have an SBI Branch as well as the State Bank of Sikkim. However villagers from Topung Village say they undertake a 3-hour journey to Pelling to reach an SBI. Most people from West Sikkim go to Pelling to access this SBI bank branch. There is also a complain from the people that ATMs do not always work well which adds to the woe of there being only 2 ATMs in Geyzing and Pelling. Fortunately, for the people who traverse this distance, SBI at Pelling is always functional as compared to the ATM at Geyzing.
There are blocks where there is no financial institution of any kind. Darap in West Sikkim is a case in point. It is widely seen that though financial services exist, their quality is poor and distribution in terms of numbers per block/village/district are very low. Financial infrastructure is comparatively better in Uttarkashi where villagers say no block is without a financial institution.

Like the rest of India, these regions are also served by a network of insurance workers, but as is the case with most services, their accessibility and frequency of visiting villages, or availing their services is poor. This could also be attributed to a lack of awareness among the people. No training or awareness sessions are carried out, say people from Purola, Chinyalisaur and Barkot. Maneybhanjang paints a more positive picture with villagers saying counseling session for insurance is carried out and 6-7 insurance agents available.

While they cater to people settled in these areas, nomadic communities and they're availing of banking and insurance services are very low. The locals say this is because the agents visit only villages and these nomadic communities are perhaps overlooked as communities wanting to avail these services.

Conclusions

Road and energy infrastructure in the mountains influences people's lives and livelihoods a great deal. Good infrastructure, by providing them an enabling environment, would allow the local communities to achieve economic diversification and in turn enhance their living standards. However, in order to ensure that infrastructure development does not harm the fragile ecology of the region and affect the social dynamics of the local communities; focus has to be drawn towards developing 'eco-culturally appropriate' solutions to address the issues pertaining to connectivity and energy. According to Dr. Dhar *"we need to take the views of the local people and make the infrastructure compatible with their system."*

This paper sought to take views of some people who have worked extensively on or in the high altitude Himalayan regions, trying to find the best solutions for the complex problems facing the region. The sum of their experiences points out the huge divide between the main agency for infrastructure development, i.e. the State and the people who are supposed to benefit from this infrastructure.

There are initiatives that have begun to bridge this gap. The government is promoting eco-tourism in the Himalayas, along with the concept of home stays in a big way. Various organizations are working on finding sustainable renewable energy alternatives for sparsely populated Himalayan villages, utilizing the source power of the sun, the wind, water, and biomass. In an effort to address the energy needs of the rural high-Himalayan communities and also create sustainable, niche-sector enterprise clusters, Pragya devised the Mountain Village Power model comprising in essence the development of decentralized energy facilities with its pilot project in the district of Lahaul and Spiti in the Western Indian Himalayas.

A number of environmental studies are being done to assess the ecological imbalance in the region. Local as well as national NGOs, with the support of various funding agencies are working with the rural community, to make them more aware of the issues surrounding them and the role they could play in alleviating some of these problems. These beginnings can be taken towards a successful conclusion only when the various stakeholder agencies work with the people who have inhabited these regions for centuries. Otherwise, the ecological, experiential, and geo-physical gift of the Himalayas will be wasted away by human shortsightedness.

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References

- Shrestha, A.B. and Eriksson, M., 2009. Climate Change in the Himalayas. ICIMOD.
- Singh, J. S.; 2006; Sustainable development of the Indian Himalayan region: Linking ecological and Economic concerns; Current Science, Vol. 90, No. 6, 25 March 2006; pp 784-788.
- Vedwan, N. and Rhoades Robert E.; 2001; Climate change in the Western Himalayas of India: A study of local perception and response; Climate Research; Vol. 19, 2001; pp. 109–111.
- Venkataraman, G., Rao, Y. S. and. Rao, K. S; 2001; Application of SAR Interferometry for Himalayan Glaciers; 8 p.
- Wagnon et al.; 2008; Four years of mass balance on Chhota Shigri glacier (Himachal Pradesh, India), a new benchmark glacier in The Western Himalayas; P. Wagnon, A. Linda, Y. Arnaud, R. Kumar, P. Sharma, C. Vincent, J. G. Pottakkal, E. Berthier, A. Ramanathan and P. Chevallier; Geophysical Research Abstracts, Vol. 10, EGU2008-A-04020, 2008.
- Agarwal, D.K. et al., 2010. Are EIA studies sufficient for projected hydropower development in the Indian Himalayan region? *Current Science*, 98(2).
- Cole, V and Sinclair, A.J., 2002. Measuring the Ecological Footprint of a Himalayan Tourist Center. *Mountain Research and Development*, 22(2)
- Dharmadhikary, S., 2008. Mountains of Concrete: Dam Building in the Himalayas [online] USA: International Rivers (Published 2008). Available at: http://www.internationalrivers.org/files/IR_Himalayas_rev.pdf
- Geneletti, D. & Dawa, D., 2009. Environmental impact assessment of mountain tourism in developing regions: A study in Ladakh, Indian Himalaya. *Environmental Impact Assessment Review*, 29(4), pp. 229-242.
- Lama, M.P., 2001. Sikkim Human Development Report. Government of Sikkim.
- Mulmi, A.D., 2009. Green road approach in the rural road construction for the sustainable development of Nepal. *Journal of Sustainable Development*, 2(3).
- Sarkar, R., 2010. Rural Accessibility and Development: Sustainability Concerns in an Ecologically Fragile Mountain Belt. *Economic & Political Weekly*, 14(21).
- Sharma, B., 2009. Sustainable energy for the Himalayan rangelands, ICIMOD. Published by: Social Science Press
- Sharma, S.K. & Bhardwaj, V., 2007. Employment Generation Through Small Hydro Projects in the Himalayan States. International Conference on Small Hydropower - Hydro Sri Lanka.
- Shrivastava, A, 2006. Are we destroying the Himalayas? Available at: http://www.thepeoplesvoice.org/cgibin/blogs/voices.php/2007/11/13/are_we_destroying_the_himalayas
- Singh, R. B. & Mishra, D. K., 2004. Green Tourism in Mountain Regions - Reducing Vulnerability and Promoting People and Place Centric Development in the Himalaya. *Journal of Mountain Science*, 1(1).
- Arunachal Pradesh Human Development Report, 2005. Published by the Government of Arunachal Pradesh, Itanagar.
- Himachal Pradesh Human Development Report, 2002. Published by the Government of Himachal Pradesh, Shimla.
- Report of the Task Force, 2010: To look into problems of hill states and hill areas and to suggest ways to ensure that these states and areas do not suffer in any way because of their peculiarities. Planning

Commission, GoI.

- ICIMOD, 1995. Mountain tourism in Himachal Pradesh and hill districts of Uttar Pradesh. *Mountain Enterprises and Infrastructure*. Discussion paper, Academy of Mountain Environics, Dehradun.
- Uttarakhand Vision 2022. Towards Robust Growth & Inclusive Development.

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