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Enabling Sustainable Development in Highland Areas in the Indian Himalayas

From its decade-long pioneering work dedicated to the economic development and environmental regeneration of the high-altitude region of the Indian Himalayas, Pragya—an NGO based in Gurgaon, India, focusing on appropriate development of vulnerable communities and sensitive ecosystems—devised the MVPower (Mountain Village Power) model. This comprises in essence the development of decentralized energy facilities for use in (a) improving rural welfare facilities, (b) creating sustainable, niche-sector enterprise clusters, and (c) providing alternatives to overuse of natural resources. A pilot project is being implemented in the district of Lahaul and Spiti in the Western Indian Himalayas. Discussion of the initial results of the project constitutes the core of this paper.

The high-altitude Himalayas

The high-altitude belt of the Indian Himalayas is a harsh expanse of wasteland and craggy slopes ringed by snow-clad peaks. The communities that inhabit this extremely tough terrain reside in scattered small villages across the valleys and plateaus, cut off from the world due to climatic and infrastructural adversities. These hardy highlanders have learned to eke out a living from subsistence agriculture and pastoralism during the short, mild summers; the winters are bitter stretches when no productive activity is possible. Poverty levels are high, and deprivation is stark. Lack of irrigation makes cultivation of cash crops difficult, and the produce is sold raw in distant markets with very low returns for the farmers. The near-total dependence on natural resources for cultivation, fodder, timber, and fuelwood is also having a grievous impact on the fragile land and further impoverishing the indigenous communities. Crop productivity is declining, and the burden on women—the traditional non-timber forest product (NTFP) collectors—is steadily increasing. This poses severe problems with regard to their health and education. The altitude is also a barrier to resource flows into the area. The extent and quality of infrastructure and basic services such as communication, healthcare, and education—considered commonplace in the plains—is pathetically poor. The developmental status of these communities is therefore far below that of the rest of India.

Development needs, opportunities, and hurdles in the high altitudes

Sustainable development in the mountains requires a focus on 3 critical issues:

- Lack of economic development in the context of inadequate infrastructure and skills;
- Lack of community development resulting from inadequate welfare services;
- Natural resource degradation resulting from overexploitation of resources.

Occupational diversity and value added to local produce have been found to be significant catalysts for development of rural areas, bringing in revenues that in turn attract other constituents of development such as welfare services and infrastructure, while reducing pressure on natural resources. Rich in resources on which plains communities depend, high mountain regions have the potential to produce a variety of niche products for which latent markets exist. In addition, the bur-

BOX 1

Characteristics of the high-altitude belt of the Indian Himalayas

- Geographical area including Ladakh, Lahaul and Spiti, Kinnaur, Pithoragarh, North Sikkim, and Tawang;
- Villages situated at altitudes between 2600 and 5300 m;
- Population density: 2–10 persons per km^2;
- Summer temperatures average 17°C and plummet in the winter to –40°C;
- 89% of the population work on their own fields;
- Markets are at a distance of at least 200 km from the area;
- Only 17% of villages in Lahaul and Spiti district possess any medical facility; 46.5% of settlements in West Kameng are electrified; 31% of villages in Tawang have primary schools.

geoning tourist market in these regions represents substantial consumption capacity for a range of goods and services.

Yet the disadvantages of mountain regions have meant a high drain of revenues and inability to realize potential advantages. These regions are characterized by a one-way extractive pattern: they provide water, timber and minerals to people downstream, but negligible benefits flow back in return. The solution lies in removing the bottlenecks that prevent mountain areas from benefiting from specific advantages associated with niche products and markets, and in developing eco-culturally appropriate solutions to address these problems.

A paucity of energy is among the most serious bottlenecks to development in the Himalayan highlands (Box 1). There are about 5000 non-electrified villages in the Himalayan region; moreover, an electrified village is not necessarily one in which all households have electricity, nor one in which electrically powered enterprises would be feasible. The quality of available power is very poor, and there are weeks of blackouts during the freezing winters. Biomass, with its severe environmental and health costs, is the major fuel, of which 60–80% is in the form of fuelwood. Women's health is damaged by exposure to wood smoke and the carrying of fuelwood loads on their heads across long distances. The ecology of the region is also severely affected, as the sparse vegetation cover is removed for household energy needs. Inadequate levels and forms of energy hinder education and make it impossible to process products and achieve added value through mechanization.

Human resource capacity in the Himalayas is severely stunted and is a further reason for the lack of development. The isolation suffered by highland communities has meant an increasing gulf in skills and technologies. Despite the immense advances made by the rest of the world, these communities remain trapped in practices that prevent them from producing and selling value-added products or new-age services, at best deriving small benefits from low-end tourism employment in the flourishing tourist markets in their regions.

BOX 2

Characteristics of Common Energy Facilities (CEFs) and their advantages for remote Himalayan villages

- Decentralized, village-level energy generation and distribution;
- Renewable energy system using 1 or more available sources;
- Micro- to pico-scale system for the whole village;
- Serving energy needs in an integrated manner, for households, welfare, enterprises;
- Equitable and total coverage of village population.

Common energy facilities for mountain villages

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. Although efforts have been made to promote renewable energy (RE)

FIGURE 1 The *pawan-chakki* or windmill built by the Lossarpas. (Photo courtesy of PRAGYA)

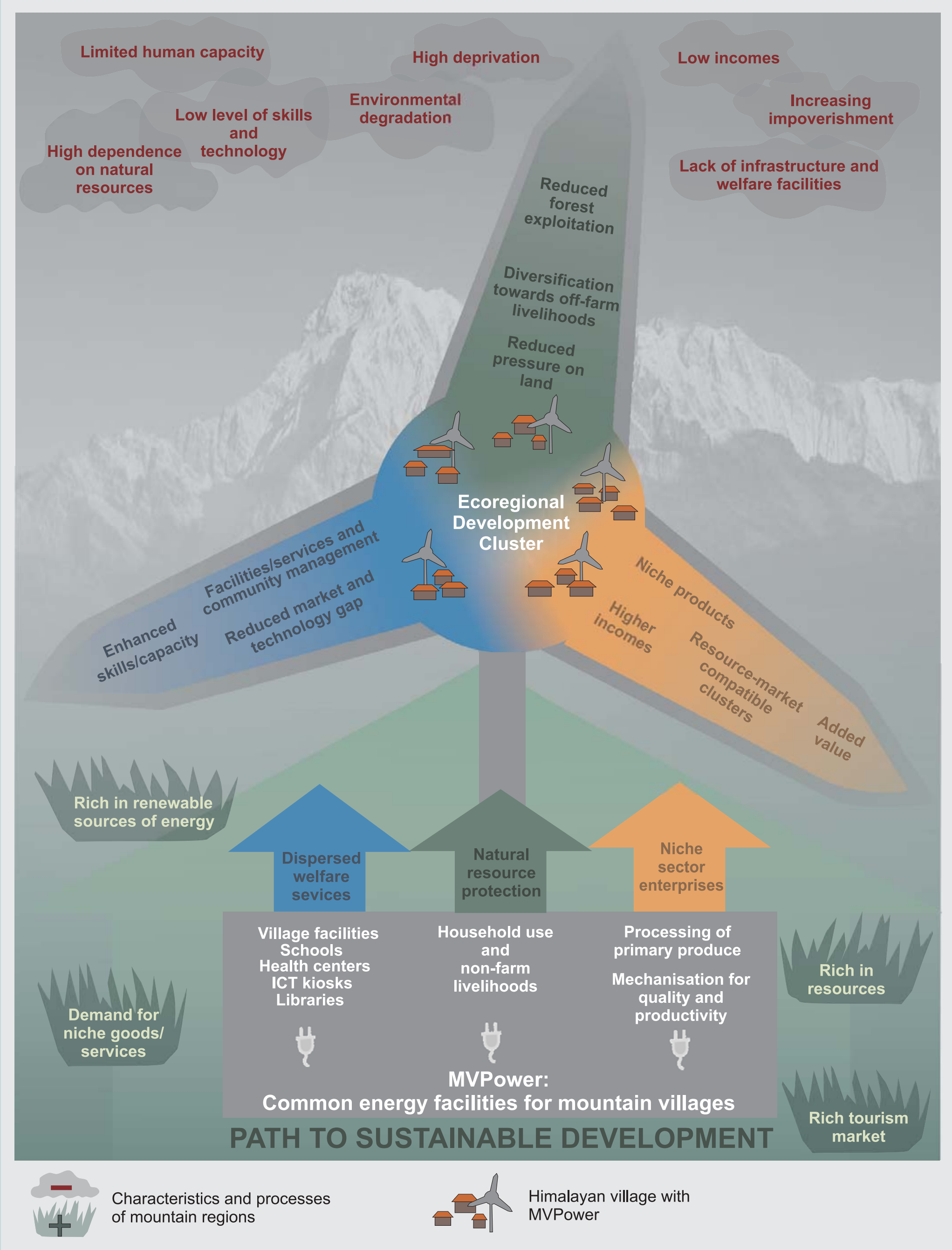

FIGURE 2 Schematic representation of the path to sustainable development for high-altitude regions, showing the environmental, social, and economic characteristics of mountain areas and the role of distributed energy systems. (Figure by Ulla Gämperli, based on graph by PRAGYA)

sources in the Himalayan highlands, the low level of penetration stems from serious gaps in adaptation of RE technologies to high-altitude social and ecological conditions. The only RE infusion in the area has been of solar photovoltaic (PV) installations, and has focused on household-level applications. This has left the poorer households that are typically unable to invest out in the cold. Larger, beyond-the-household energy needs for welfare facilities and enterprises are also left unaddressed.

The dispersed nature of habitation in the region necessitates decentralized energy generation (Box 2 and Figure 1) and distribution services. The lower capacity of the community, along with great homogeneity and cohesion, also calls for community rather than household-level energy units. Pico- to micro-scale power generating systems using renewable sources of wind, sun, and/or water available at the particular site may be installed in a village and cater to all village-specific energy needs. A green energy solution for remote, energy-deprived mountain villages, such Common Energy Facilities (CEFs) may be jointly invested in and managed by the village community. Unlike household RE appliances, a CEF can ensure power for the poorest households that would not otherwise be able to enjoy it, and address larger, community-level energy needs alongside household needs.

The path to sustainable development for highland communities (and the role of CEFs)

Dispersed rural services

In light of restricted access and movement in the region for a significant part of the year, the reach of basic services such as health and education—the route to enhancing the capacity and quality of life of Himalayan communities—can be ensured by village-level provision and management of these services (Figure 2). A CEF can cater to household electrification in the village and also act as a critical enabler for improving the level of rural services. Schools and health centers disadvantaged by a lack of power can be supplied by energy generated through CEFs. Supplementary facilities, such as rural education centers and ICT kiosks, can also be enabled and in turn aid the development of mountain communities and their economic mainstreaming.

Alternatives to overuse of natural resources

Sustainable use of ecosystem resources requires development and institution of alternatives to overused natural resources. Fuelwood needs to be replaced with renewable sources, while the escalating conversion of forestland to agricultural land and overgrazing of pastureland to meet people's livelihood needs can be slowed down or halted with the infusion of alternate, non-farm occupations such as agri-produce processing, handicrafts, and ecotourism. By addressing household heating requirements, CEFs can significantly reduce fuelwood use and the associated burden on women. They can also enable mechanized economic activities as livelihood alternatives, improve resource productivity, and reduce resource use.

Niche sector clusters

Economic development efforts in the highlands need to concentrate on creation of development clusters for ecological and cultural niches. Geographic proximity and commonality of resources and activities can give the cluster constituents the economic benefits of several positive externalities. Forward linkages with regional techno-economic networks can ensure product–market compatibility for these clusters and help them keep pace with ongoing development in the region while contributing to balanced regional growth. Cluster development in the Himalayas can be enabled by CEFs and facilitated to incorporate primary to secondary-level processing as well as suitable packaging and marketing. Area-specific produce such as medicinal plants and crafts can be developed as niche sector products. CEF-powered clusters can thus open up new livelihood avenues that involve less physical drudgery, while

BOX 3

The Lossar solar–wind hybrid Common Energy Facility (CEF): site conditions, system features and the installation process

- Has a capacity of 2.1 kWh, comprising 14 solar PV panels generating 1 kWh, and a windmill generating 1.1 kWh;
- Fulfils lighting and power requirements for the operation of equipment in a Community Work Station, a Village Education Center, and a Primary Health Center;
- Generates a maximum of 7 units/day and can thus supply power for 4 hrs/day for 2 days when there is no power generation.

FIGURE 3 Villagers volunteering to set up the windmill in Lossar. (Photo courtesy of PRAGYA)

FIGURE 4 Adolescents at the Education Resource Center; both boys and girls can take advantage of the facility. (Photo courtesy of PRAGYA)

improving rural incomes. This can greatly improve the quality of life for mountain people, and for mountain women in particular.

The CEF that has revolutionized life in Lossar

Powerless, cold, and dreary winters are a reality for remote high-altitude villages such as Lossar in Lahaul and Spiti District, one of the highest inhabited villages in the Indian Himalayas. Lossarpas spend their summers farming small plots of land, grazing their livestock on adjoining rangelands, and employed in back-breaking road labor in order to earn a small cash income. The village has a primary school and a health center, both of which are frequently inoperative. The road to Lossar closes every October and the village remains snowbound and isolated until June. Villagers rely on fuelwood to meet energy requirements for cooking and heating. Although the village is connected to a grid, there is no power for most of the winter and long stretches in summer. Among potential RE sources in the area, water lies frozen in winters and the sun and wind make their presence felt alternately. Pragya, an NGO working in the region, designed and installed a pico-scale (smaller than micro, with a maximum output of 5 kWh) Solar–Wind Hybrid System (Box 3 and Figure 1) for the village. This harnesses one RE source when the other is in short supply, ensuring uninterrupted power for select village facilities and some households as well.

Establishment and management

A community task force was constituted for the installation, and every Lossar family volunteered a few days of labor to the project (Figure 3). Select local youth were provided with intensive training in operation and maintenance of the CEF as well as in assembling small RE applications. These young people are being developed as a cadre of rural “technopreneurs” for local-level Renewable Energy Technology (RET) sales and service to reduce the community’s dependence on distant service providers. The village governance council has taken up the management of the CEF and the facilities it supports, instituted membership subscriptions for these facilities, and established a system of service charges from other users as well as a refundable deposit against potential damage.

BOX 4

Impacts of the Lossar project in the words of its children—A poem

Our windmill is very close to our hearts,
Our windmill is incomparable,
Our windmill is the very best,
Our windmill is our great friend.

If our windmill were not there
How would we study all night?
If our windmill were not there
How would we write all night?

Our windmill gives us heat,
Our windmill gives us light,
If our windmill were not there
How would we watch TV?
If our windmill were not there
How would we excel in exams?

Our windmill is very close to our hearts,
Our windmill is incomparable,
Our windmill is the very best,
Our windmill is our great friend.

By the children of Lossar,
translated by Pragya

FIGURE 5 Women at the CEF-powered Community Work Station at Lossar. (Photo courtesy of PRAGYA)

Early impacts

The CEF, Lossarpas decided, would be applied for electrification of welfare facilities, such as a Village Education Center and the Health Center. The CEF-supplied power has lengthened study hours for children and provided access to a variety of educational resources in the education center for children and adults alike (Figure 4 and Box 4).

The Health Center has also been made more effective, with uninterrupted power from the CEF. Power generated from the CEF provides heating and lighting for a community work station as well, that is used by a women's group for weaving carpets and shawls—crafts that were dying a slow death as the availability of fuelwood declined and the space housing the looms could no longer be heated. The CEF has helped the women generate income through sale of crafts to tourists, replacing road labor with less strenuous weaving, and developed crafts production into a niche enterprise (Figure 5).

The weaving center also doubles as a Community Utility Center and is helping to strengthen social ties through community meetings and celebration of festivals. The power generated when the common facilities are not in use is provided to a few households. This has greatly improved the quality of life for these households and also reduced their fuelwood use, in turn making women's lives much easier. The dark dreary winter scenario of complete isolation from the rest of the world has now changed for the Lossarpas, with regular supplies of electricity and access to satellite television and telephones, even during the winter months. The impact of this initiative in Lossar is thus not restricted to activities related to improving material conditions and rural amenities; it has had positive impacts on community relations, education, and other nonmaterial elements as well.

Conclusions

The CEF ably demonstrates the potential of distributed power generation, not only in overcoming the energy bottleneck, but also in effecting social and economic development and ensuring ecosystem integrity. It can mean improvement of the quality of life in high Himalayan communities, as well as their empowerment with information and connectivity with the rest of the world. It can mean an improvement in the lot of mountain women, the backbone of Himalayan society. It can facilitate diversification into alternate livelihoods and supplementary incomes, which would in the long run help raise Himalayan communities out of the mire of deprivation, reducing the gulf between them and plains communities. Improvement of their educational and health status through provision of welfare facilities, as well as improvement of ecological conditions by reducing deforestation, would also boost the quality and productivity of both human and natural capital.

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