Enhancing Market Access and Livelihood Options in the Himalayan Region through Gravity Ropeways

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Improving roads and bridges along steep, fragile, and rough terrain across scattered settlements is a major development challenge for governments across the Himalayan region. Access to markets for many mountain products and resources is severely limited, as is the delivery of development inputs and services to mountain communities.

Poor accessibility in mountain areas also means marketable services and niche resources remain grossly underutilised and undervalued. In remote parts of the greater Himalayan region, human porters, mules, goats, and yaks continue to be the principal means of transport. Not only is the human drudgery associated with transporting loads on people backs high, the long travel time and the low volume of freight that people and animals can transport make marketing mountain products and natural resources uneconomical. Unless per unit transport cost can be reduced and trade flows – primarily exports – are increased, mountain areas are unlikely to benefit fairly from trade. Globalisation and trade are likely to further accentuate the already unfavorable terms of trade and marginalise mountain people in the very environment and with regard to the very products which should give them comparative advantage. Poor physical accessibility will continue to be the single main obstacle to harnessing the comparative advantages of mountain areas. Although low-cost, labour-intensive roads have been designed to reduce construction costs, roads in mountain areas cannot fully cover the scattered settlements. Investments in roads in mountain areas are also difficult to justify environmentally. Topography makes even the shortest trip time-consuming, as road and path systems hug contours and wind slowly up and down gradients across hillsides.

Gravity ropeway (GR) technology is a cheap and simple means of transport based on the force of gravity to move goods between two points on a linear path. A heavier load is allowed to slide down at a certain angle; the same force helps to pull a slightly lower weight from the other end (see photo). A flywheel with a bearing and bracket located at the downhill station is used as a brake. The operator at the upper end strikes the wire rope with a stick to send a wave signal to the operator at the lower end. The person at the lower station then applies hand brakes, to control the flywheel.

Since the ropeways traverse straight paths, capital, operation, and maintenance costs on a per km basis are all low. The technology relies entirely on gravity and hence does not require external fuel and

A comparison between GR and other ropeways that require external energy is provided below.

Gravity Ropeways	Other Ropeways
Low-cost technology	Medium- or high-cost technology
Appropriate technology	Modern technology
No external power required	External power (electricity or fuel) required
Local people can the manage system	External expert should be hired
Two operators can operate system	More than two operators are needed to run the system
Low repair and maintenance costs	High repair and maintenance costs
Local operator can replace ropeway parts	External expert required for replacement of parts
Mainly used for short spans (maximum 2.5 km)	Mainly used for longer spans

is non-polluting. It reduces transport time and drudgery and is easy to operate and can be managed and maintained by the mountain communities themselves. The technology is not new and has been in operation for a variety of purposes for many years. Ropeways have been used to transport timber, limestone, and farm products.

Ropeways are environmentally friendly and require minimal infrastructure at ground level. They are suitable for earthquake and landslide-prone areas.

In partnership with Practical Action Nepal (PAN) (formerly Intermediate Technology Development Group [ITDG]-Nepal), ICIMOD has supported the construction of two pilot gravel ropeways in Mustang district, Nepal. The ropeway has helped reduce women's travel time and the drudgery associated with it. Using the ropeways, women are now able to transport firewood, fodder, and other natural resources to their villages from the forests. The technology has eased the bulk transport of apples and has allowed these products to be moved quickly to their markets, thereby minimising spoilage. Instead of porters, local people now use the ropeway to carry inputs. After the ropeways' installation local market prices of imports have gone down by almost 5%. This has helped farmers and traders realise similar increases in their profit margins. The ropeways are managed and operated by a committee of local people.

Economics of gravity ropeways in two hill areas

ICIMOD and PAN have also completed a feasibility study for two gravity ropeways in Nepal. The first is on the feasibility of a gravity ropeway connecting Janagaun village in Dhading district to the roadhead along Prithvi Highway. The second study is on the feasibility of a gravity ropeway to connect Chapakharka village located on the ridgetop above the ICIMOD Training Demonstration Site at Godavari to the roadhead. Currently, portering is the only means of transportation in both villages.

In Janagaun it takes about three hours to get from the village to the road head carrying a 50 kg load. The current transport cost by porters is about Rs 1.75 per kg. The proposed ropeway (1.35 km) would reduce this time to just 10 minutes. With the ropeway, the minimum transport cost that needs to be charged is Rs 0.18 per trip to meet the full annual operating and maintenance costs as well as the replacement cost; it is financially sustainable. If villagers increase their

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A gravity ropeway under construction using local labour and materials

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Testing the newly constructed gravity ropeway in Janagaun, Dhading District, Nepal

Summary results of an economic cost-benefit analysis of gravity ropeways in Janagaun and Chapakharak villages

Scenarios	PRESENT VALUE (NRs)		NPV @ 12% discount rate (NRs/km)	EIRR	BC ratio	Switching Values*	
	Cost	Benefit				% Increase in cost**	% Decrease in benefits**
Base Results							
• Janagaun	1,004,263	3,298,765	2,294,502	55.89%	3.28	228%	-70%
• Godavari#	894,918	1,584,573	689,655	27.35%	1.77	77%	-44%
Sensitivity Results							
Total project cost increase by 20%							
• Jangaun	1,205,116	3,298,765	2,093,649	45.76%	2.74	174%	-63%
• Godavari#	1,073,902	1,584,573	510,671	21.72%	1.48	48%	-32%
Total project benefits decrease by 20%							
• Jangaun	1,004,263	2,639,012	1,634,749	43.73%	2.63	163%	-62%
• Godavari#	894,918	1,267,658	372,740	20.57%	1.42	42%	-29%
Total cost increase and benefits decrease by 20% each							
• Jangaun	1,205,116	2,639,012	1,433,896	35.57%	2.19	119%	-54%
• Godavari#	1,073,902	1,267,658	193,756	15.84%	1.18	18%	-15%

* Switching value to bring EIRR to 12% (i.e., discount rate)
** Negative values imply decrease in cost/benefits
# Preliminary result from cost-benefit analysis

marketable surplus of vegetables, fruit, and other products (i.e., producer surplus) the benefits that accrue from ropeways will be even greater. For example, with producer surplus, the economic internal rate of return exceeds 50%.

The cost-benefit ratio of installing a gravity ropeway in Chapakharka is equally encouraging. Without a ropeway, it takes a porter approximately two hours to bring goods into Godavari market from Lattle Bhanjyang (upstation) and one-and-a-half hours going back. Porters currently charge about Rs 65 to carry a 50 kg load. The proposed ropeway (1.35 km) would reduce this time to less than 10 minutes. The minimum transport cost that needs to be charged to make the system financially sustainable is only Rs 0.26 per trip.

The Table above summarises the cost-benefit ratio of gravity ropeways in two sites showing their estimated economic internal rate of return (EIRR), net present value (NPV) per km, and the benefit-cost (BC) ratio along withan switching values to understand the sensitivity of the results under different scenarios. The results indicate that a ropeway at both sites is justifiable on economic grounds with an estimated EIRR many times higher than the cut-off discount rate (12%) and the BC ratio greater than unity.

Conclusions

Gravity ropeways represent an effective and viable mountain technology for enhancing market access and livelihood options, and for reducing drudgery in mountain areas. While the saving in transport costs alone is sufficient to make the system financially viable, the technology should be promoted using an integrated marketshed approach to enhance marketable surplus with complementary investment in production pockets. When marketable surpluses are increased, connecting isolated settlements to roadheads not only further encourages marketable surpluses and contributes to improving livelihoods in the mountain areas, it also adds value to generally underutilised mountain roads.

The huge savings in transportation time and cost makes gravity ropeways economically viable in mountain areas.