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Vir Singh

*G. B. Pant University of Agriculture and Technology, India*

Babita Bohra

Manisha Joshi

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## **Rangeland , ecological integrity and sustainability : an analysis in the Himalayan Mountain context**

Vir Singh<sup>1</sup> , Babita Bohra<sup>2</sup> and Manisha Joshi<sup>3</sup>

<sup>1</sup> Professor of Environmental Science , <sup>2</sup> Rangeland Consultant , <sup>3</sup> ex-JRF , c/o Jeewan Khulbe , D-96 , 2<sup>nd</sup> Floor , South City-II , Sohna Road , Gurgaon , ( Haryana ) India , E-mail manisha\_svs@yahoo .com

**Key words :** agroecosystem , ecological integrity , Himalayan mountains , rangeland , sustainability

**Introduction** Ecological integrity of a system is a precondition to sustainability (Singh 2007) . Rangelands that occupy large chunk of the geographical area in the Himalayan mountains have a key role to play towards imparting high degree of sustainability to an agroecosystem and thereby to the land-based livelihoods in the mountain areas . Ecological integrity of a system is ensured when there are ecological linkages between components of the system and , as a result , there is considerable flow of water/ moisture and nutrients within the system . Factors influencing bio-geochemical cycles , water cycle and climate regulation are pivotal for ensuring ecological integrity at macro-level of a geographical area . This paper discusses the crucial role of rangelands in imparting considerable ecological integrity vital for the sustainability of agroecosystems in the fragile Himalayan mountains .

**Materials and methods** The content of the paper is largely drawn on basic principles involved in generating conditions for sustainability through ecological integrity , which is based on long-term experiences of studies in the Indian Central Himalayas .

### **Results and discussion**

**Rangeland-livestock-Farming linkages** Ecologically more stable rangelands impart resilience to an agroecosystem and appropriately respond to the inherent fragility of the mountains . Livestock feed on range plants and retain a proportion of energy and nutrients for their maintenance , while the rest is converted into draught power and products (milk , wool , meat , etc .) . A proportion of the consumed biomass is voided as dung and urine which , as manure , is transferred to the cropland for the maintenance of soil fertility inevitable for food production . Crop residues to come from croplands are also fed to livestock and a proportion of energy and nutrients , as manure , is recycled into the cropland soil . Mediated by livestock , this nutrient flow contributes to the essential ecological integrity and sustainability of the agroecosystems .

**Nutrient flows** Nutrients are a collection of chemical compounds , minerals and elements essential to the survival of living organisms . Nutrient cycles are a sub-set of broader class of global biogeochemical cycles , including water , carbon , oxygen , nitrogen and mineral cycles (Bourn *et al* . 2005) . Plants take up nutrients from soil reserves and atmosphere and accumulate in their biomass . A proportion of this is consumed by animals and the other flows through the environment . The passage of nutrient flows in the environment is a nutrient cycle . Biogeochemical cycles , especially those of NPK , are significantly influenced by agriculture . Livestock also contribute to affect/ regulate the nutrient flows .

**Ecological integrity and sustainability** Rangelands , as integral component , contribute to enhance complexity and impart considerable ecological stability to the whole agroecosystem . Useful biomass to be used as fuel , fodder , fibre , raw material for industries , edible fruits , vegetables , medicinal herbs , honey , etc . Ecosystem services of ecologically sound ecosystem are more intense , more useful and congenial for the optimum agricultural production . Conservation of myriad life forms , water/ moisture circulation , and maintenance of appropriate micro-climate are the other intangible attributes of the rangeland ecosystems . All these socioeconomic attributes and ecosystem functioning are important indicators of sustainability .

**Conclusions** Rangelands covering largest chunk of geographical area in the Indian Central Himalayas are pivotal towards generating , regulating , and optimizing factors that ensure ecological integrity of and consequently impart sustainability to the mountain agroecosystems .

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