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**Chhaya Singh**Government Degree College,  
Thalisain, Pauri District,  
Uttarakhand, India**Neha Chauhan**Department of Medical  
Microbiology, College of  
Paramedical Sciences Shri Guru  
Ram Rai University, Dehradun,  
Uttarakhand, India**Sushil Kumar Upadhyay**Department of Biotechnology,  
Maharishi Markandeshwar  
(Deemed to be University),  
Mullana-Ambala, Haryana,  
India**Raj Singh**Department of Biotechnology,  
Maharishi Markandeshwar  
(Deemed to be University),  
Mullana-Ambala, Haryana,  
India**Anju Rani**KV Subharti College of Science,  
Swami Vivekanand Subharti  
University, Meerut,  
Uttar Pradesh, India**Corresponding Author:****Chhaya Singh**Government Degree College,  
Thalisain, Pauri District,  
Uttarakhand, India

## The Himalayan natural resources: Challenges and conservation for sustainable development

**Chhaya Singh, Neha Chauhan, Sushil Kumar Upadhyay, Raj Singh and Anju Rani**

**Abstract**

The natural resources in attendance on the earth form an important part and have the capacity to fulfil demands. The Himalaya is dwelling to millions of populace, multitudinous inimitable species; verities of cultural and spiritual heritage, and cover almost 2,500km from east to west in Asia. There are about 10,000 types of plants, 750 species of aves and nearly 300 mammalian species reported in eastern Himalaya only. This is hot spot of many endemic species which do not bring into being elsewhere. Despite its rough terrain standing the Himalaya is a blend of easily broken or flimsy environments and features array of challenges. It is the source of some great rivers such as Indus and Ganges, whose longevity and streaming affected by changes in climate conditions. The augment of human interference in Himalayan region have made endemic species of the area vulnerable on the way to extinction. These are at present under stress due to over-exploitation therefore; it is now become fundamental to conserve these natural resources. The sustainable management and development is a modern approach towards this problem as it would maintain and improves livelihoods of local communities. Therefore, it is urgent need to ensure that tourism, oil, gas and hydropower build up in eco-friendly approaches that masquerade no threat to the environment and incredible biodiversity. This review will provide a new dimension in management, protecting and restoring habitats of the wildlife to maintain ecological balance and sustainable use of natural resources.

**Keywords:** Himalayan region, biodiversity, sustainable development, wildlife, hot spots, natural resources, conservation

**Introduction**

The Himalaya, *sensu stricto* is imperative array of mountains that apart India, next to its north-central and north-eastern frontier of China, and flanked by 26°20' to 35°40'N (Lat), and 74°50' to 95°40'E (Lon). The Himalaya is foundation of one of the prime revenue of snow, frost and its glaciers as consecutive resource of fresh water to perpetual/eternal, perennial rivers like the Indus, Ganges, and Brahmaputra (Ives and Messerli, 1989) [21]. The Himalayan bionetwork is diverse, threatened and vital to ecological security of the Indian atoll/geography as the source of jungle/woodland cover, biodiversity, richness for worthy agriculture, irrigation, drinking water, hydropower, and picturesque countryside/topography for sustainable tourism (Acharya *et al.*, 2017) [1]. The region is inhabited largely by indigenous societies. The areas are enriched with biodiversity of the country and the hilly people are dependent upon biodiversity for meeting with their livelihood needs (Samant *et al.*, 2011) [45-48]. The medicinal potential of the North-West Himalayan plants are well acknowledged from the early time of the great epics of the Ramayana and Mahabharata and written in the oldest Hindu scriptures, viz., Rigveda (Bhushan *et al.*, 2016) [10]. In the Atharveda there are collections of medicinal plants, which is said to be the source of Ayurvedic medicine system. The exploration and protection of medicinal plant is necessary for pharmacological research and development, different studies revealed the medicinal potential of the Himalayan regions (Samant and Dhar, 1997; Salick *et al.*, 2009; Samant *et al.*, 2011; Singh and Rawat, 2011; Kuniyal *et al.*, 2015) [44-48, 54]. Thus satisfying biodiversity in the region is protecting the interest of the people and characterised a rich reservoir of plant and animal prosperity natural systems. At different spatial and organizational levels these ecosystems reflect mosaic biotic communities. Some zonal studies assessed the ethnobotanical significance of the area (Singh *et al.*, 2018; 2019; 2020) [47, 53-59, 66]. Since Himalaya is among 34 Global biodiversity hotspots, reflecting wide ranging ecological significance. As a geographical exposure, the Indian Himalayan Region (IHR) is extend over 5.3 lakh km<sup>2</sup> including huge mountain range over 2500 km sandwiched between two river Indus and Brahmaputra. The IHR ranging from low-lying plains to over 8km ASL with 300 km widest part and middling width of 80 km.

(TME, 2006) [60]. In a report it was acknowledge that development of mountain areas proceeds alongside a to some extent different itinerary than that of the plains. After overabundance of gossip in the order of the "Rio process", including the State of the World's Mountains manuscripts and subject-wise reports of different countries, those differences carry on (Prakash, 1993) [38]. As an input to the Himalayan improvement contest, this plan will serve a purpose; as a basis for the eco-development of the Himalaya.

### Challenges to Himalaya region

It is evident world-wide *sensu amplo* trends showing exploitation of natural resources at to a large extent tariff than those at which these possessions get hold of replacement The Himalayan flora and fauna is prone and vulnerable to the influence and consequences of: (a) alterations in natural causes, (b) anthropogenic discharge foremost to climate change, and (c) way of the modern civilization. The fundamental cause of enlarging gap linking resource utilization and replenishment in the prosperous regions is the augment in per capita. The population bang is supposed to be the prompt determinant of such trends in developing and underdeveloped territories. Human has been demolishing forest for several decades ever since agriculture came into existence and now approached to deforestation in the Himalayan zone (Mahat *et al.*, 1986; William, 1989) [29, 54]. The foremost predicament in Himalaya is dilapidation of forest cover which provides pathways diverse problems like soil erosion, slope failures, depletion of soil fertility, paucity of fuelwood and fodder, amplified overland flows, abridged ground water recharge hammering biological diversity and accelerated siltation of river beds in lowlands areas (Das *et al.*, 2016; Mahapatra *et al.*, 2018) [14, 28]. The strong affiliation occurs between population growths and augment continuation crops areas; and rising in livestock populace is very much interrelated to boosted forest demands. Rao and Saxena suggested that there was negligible renovation of forest to agriculture in last 60yrs in central Himalaya (Rao and Saxena, 1994) [40, 41, 43]. However, the excellence of sustaining land has declined because of disintegration and lack of concern towards commons (Singh *et al.*, 2013) [47, 53-59, 66]. The finding of some other scholars stated that rose fuel wood demands were the cause of reduction forest perimeters or circumference around the habitations or residential locality in mountains (Ali and Benjaminsen, 2004) [4]. Based on the demand and need, these are competitive resources, therefore the attraction and urge for fodder/fuel is leading to reform canopy openings inducing rise in invasive flora.

The invasive plants are believed to cause impediment with tree saplings regeneration, and raise the probability of frequent fires through totting up of effortlessly combustible fuel loads. It gave rise to supplementary trouble in these situations leading to scarcity of leaf litter which is compulsory for animal bedding and manure (Moench and Bandyopadhyay, 1986; Chitale and Behera, 2019) [13, 33]. An earlier report based on the case study of Kumaon district, Himalaya concluded that due to increase in human and animal populations most of the degradation of forest lead to unpalatable weeds stage (Jackson, 1993) [22]. According to him such scenarios were very common in central Himalaya. As the Himalaya covers 15% total geographical vicinity of the country still it houses 28.8% of the endemic and prevalent dicot flora of the country (Chatterjee, 1939) [12]. The area was perhaps underestimated in terms of biological affluence (in terms of number of species) bearing in mind the prominence

of survey and credentials of genetic wealth of knotty mountainous areas. The main threat to the irreparable losses to the biological diversity is deforestation.

It is now required to think about a pan-Himalayan strategy which would state and evolve common policies and not follow the race to the bottom. These strategies ought to be based on regional natural resources as jungles, water, biodiversity, organic and quality foods, natural tourism still necessitate to come up to the particular threats so that development does not come at cost of environment (Milcu *et al.*, 2013) [32]. The diverse sectors are to be explored and questions that need to be discussed and resolved. The standing forest covers of the region are considered as key pool of biodiversity. These jungles and biodiversity furnish security against soil erosion and frequent flooding in plains and are potential sinks for carbon also (Ghosh *et al.*, 2016) [18]. The governments of Himalayan states are working on estimation and substantiation of values of ecosystem and carbon impounding services of its standing forest covers also (Singh, 2007; Anonymous, 2010) [5-7, 47, 53-59, 66]. This question should be discussed with local communities addressing their concerns dependent on forests for their agriculture and basic needs and a common policy evolved so that Himalayan states can "value" their forests better.

The studies carried out in the high Himalayan villages reflected act of forest resources as most essentially for fodder and water sources for sustenance of agro-farming practices along with source of water supply to plains flowing high glaciers and mountains (Zobel and Singh, 1997; Anonymous, 2009; Raina, 2009) [5-7, 47, 53-59, 66]. This resource has to be explored both in requisites of its opportunity along with risk to its ecology and economy. Presently, there is a competition to put up run-of-the-river projects and dams across the Himalayan province (Singh, 2006) [47, 53-59, 66]. The governing agencies of Himalayan states/ territories are issuing hydroelectric projects to private or self-financed companies at a rapid rate and the Uttarakhand alone on the Ganga basin has acknowledged projects over 10,000mw of power and planned for 70-odd projects (Narain, 2015a) [34, 35].

The hydroelectric power is serving as main source of renewable energy and centre of revenue generation to the states. The developments of their hydro resources are a revenue trade-off have been assessed, that would be helpful to take the pressure off to its forests or green covers (Huber, 2019) [20]. Still it is our urgent urge to comprehend the impact of same development on the ecology and hydrology of the Himalayan region. The hydrology will be impacted by the climate change and the poor construction of hydropower projects may be the reason of the flood in Uttarakhand. It is well-known that the rivers cannot be regenerated or must not be reconstructed; however, dams can be reengineered and installed on available water resources for power generation (Narain, 2015b) [34, 35]. Thus these projects should be given second thought and needs to be implemented.

Based on a report of International Centre for Integrated Mountain Development (ICIMOD), Nepal (2009) [29], the objective of building small projects must be to supply local energy demand through interactive grids. Therefore, small hydropower projects (below 25MW) were devised at beginning to provide an alternative local energy for lightening, cooking against firewood source in remote areas but it failed as concept has been changed and all projects now feed to the National/State grid, that may or may not reach local communities successfully. As this new concept lack access of energy to households in the far-flung regions of the

country, therefore, the objectives of small hydropower projects should be reassess.

### Action plans to Himalayan issues

The National Action Plan on Climate Change (NAPCC) under Ministry of Environment and Forest has enunciated and launched the National Mission for Sustaining the Himalayan Ecosystem (NMSHE) in 2008 to address the issues of Himalayan regions (Pandey, 2015) [37]. The assignment desires to make available better livelihood by identifying the coupling between the Himalayan ecosystem and the climate factors. It also aimed to reassess and comprehend inputs for Himalayan sustainable development keeping in view of the fortification or security of this delicate and easily breakable ecosystem (Xu *et al.*, 2009; Shreshtha *et al.*, 2012; Tewari *et al.*, 2017) [62, 65]. Experts from climatologists, glaciologists and others joint effort will be required to attain the objectives in shaping of natural Himalayan resources and climatic factors. The exchange of views and information with south Asian provinces and territories contributing or sharing the Himalayan resources will also be mandatory for restoring and fascination the Himalayan biodiversity revenues (Jodha, 1992; Rao, 1994; Dhar, 1997) [40, 41, 42, 43]. It is also needed to ascertain an experimental, pragmatic, and keen monitoring set of connections for the Himalayan environment to estimate and substantiate forest and hydro resources along the health of ecological unit (Zobel and Singh, 1997; Samant *et al.*, 1998; Raina, 2009) [45-48, 53-59, 66]. The mission trying to take in hand some issues which are of main concern such as Himalayan glaciers and associated hydrological consequences; security and conservation of biodiversity; maintenance and management of wild life; storing up traditional culture, societies and their livelihood; forecasting and scheduling plan for sustainable Himalayan ecosystem. The Union Cabinet has approved the Mission document on the NMSHE in 2014 with a budget outlay of INR 550 crore for 12<sup>th</sup> five year Plan period with a primary to build up in a time bound approach a sustainable national capacity to constantly gauge the health status of the Himalayan ecosystem and make possible policy bodies in their policy-formulation actions as also to facilitate states in the Indian Himalayan region with operation of activities chosen for sustainable development.

### Organic farming in Himalaya landscape

The Indian states of Himalayan regions and most of the foreign countries sharing the Himalayan boundaries have initiated and employed the innovative organic farming to obtain the quality products of its region to strengthen the health and economy for better livelihood and sustainability (Mandal *et al.*, 2006) [14, 30]. In the same line north eastern state Meghalaya was the first to declare itself an organic state followed by Sikkim and thereafter, Uttarakhand has launched major programme to encourage organic green agro-farming the state and acknowledged the opportunity of keeping organic agro-farming (Verma *et al.*, 2015; Taneja, 2017) [30, 62, 63]. The different barriers coming across the states to use their unique strength are constrain in certification and imposed forest laws. As the Sikkim has promoted organic cardamom crop but it has been noticed that forest laws did not endorsed them to take benefit of farming on these lands, even though the practice of organic farming working without destroying forests (Gudade *et al.*, 2013) [19]. The women farmers working on the slopes of the Himalayas are spending huge energy in collection of fodder, feeding to cattle and transporting to dung to manure manufacturing sites. The 20 tonnes dung per

hectare on nutritionally deficient lands is applicable but mostly gets pitiable returns (Melese, 2016; Järvan *et al.*, 2017) [23, 31]. Thus the future of agriculture should also be discussed.

### Tourism and Himalayan environment

The Himalayas' high mountain, adventure, biodiversity and nature are the route of economy and development in the regions. The tourism of any region is mostly determined by the ecology of the surrounding. If the manmade activities degrade the environment, tourism will also be affected, though the tourism is also a deteriorating cause of environment when not managed cautiously (Briassoulis and van der Straaten, 1992; Faraji and Aghajani, 2010; Rasekhi and Mohammadi, 2015; Asadzadeh and Mousavi, 2017) [8, 11, 16, 42]. The lesson Uttarakhand flood in yesteryear teaches to must focus on sustainable models for pilgrim-based tourism in the delicate Himalayan hilly regions (Basu *et al.*, 2016; Aggarwal, 2018) [2, 9]. The most common problem of high Himalayan tourist sites are pollution, litter and solid waste disposal, uncontrolled construction activities of highways, hotels and lodges leads to deterioration of Himalayan areas (Kulshrestha, 2019) [25, 26]. The perception of eco-tourism desires to be promoted cautiously so that best practices can be followed and applied which should benefit local people financial system also. Keeping environmental issues in central point the Government in Leh has encouraged outbuildings tourism with considerable notice towards combating pollution in the town and ecological security (Akhtar and Gondhalekar, 2013) [3]. Thus there is requirement of eco-friendly Nation building policies to encourage mountain tourism for countryside remuneration and welfare without affecting natural Himalayan resources.

### Wildlife conservation in Himalaya

The Indian Himalayan Region (IHR) is one of the rich biodiversity regions of the world with over 10,000 plants, 300 mammals, 977 birds, 281 herpetofauna, 269 fishes, several species of invertebrates and microorganisms, many of which have global conservation significance (Samant *et al.*, 2007; Anonymous, 2015; Sathyakumar *et al.*, 2018) [5-7, 45-48, 50, 51]. Despite significant ecological, hydrological and biological values, the fragile mountain ecosystems in the IHR are seriously threatened due to increasing anthropogenic pressures, mainly development. In the IHR, wildlife species are threatened due to poaching for meat, illegal wildlife trade, negative human-wildlife interactions (conflicts), habitat loss, habitat fragmentation and degradation due to developmental activities and natural resource use by humans (Gaston *et al.*, 1983; Negi, 2007; Sathyakumar and Bashir, 2010) [27, 36, 43, 50, 51]. These have led to a decline in wildlife population, reduction in distribution range and in some cases local extinction of species. The Ministry of Environment, Forest and Climate Change Govt. of India in association with United Nations Development Programme (UNDP) was launched a project on 'Securing livelihood, conservation, sustainable use and restoration of high range Himalaya' under the Global Wildlife Program (GWP) in 2017. It is a seven-year program funded by the Global Environment Fund (GEF) led by the World Bank, that was developed as response to the growing crisis of illegal trafficking in wildlife and address the growing concerns to conserve the animal wealth of the region. India's ongoing conservation efforts include establishment of a National Biodiversity Strategy and Action Plan (NBSAP). In addition, India is a participating state in CITES (Convention



on International Trade in Endangered Species of Wild Fauna and Flora) Rhinoceros Enforcement Task Force. The country also launched the National Mission on Himalayan Studies (NMHS), and in 2009 launched the Recovery Programme for 16 Critically Endangered Species that includes the snow leopard.

### **Pollution: Threat to Himalayan ecosystem**

The growing concern is the plight to Himalayas on the same putrefies of the cities as plains. Such unmanaged civilization will transformed into the mountains of garbage and plastic, unprocessed sewage, unrelieved water scarcity, unplanned municipal expansion and flush air pollution due to vehicles (Kumar *et al.*, 2016; Kulshrestha, 2019) <sup>[25, 26]</sup>. Therefore, the Himalayan towns should be planned specifically in keen consideration to dash of summer season tourism which will not pay to municipal services. Most of the Himalayan states have imposed plastics ban, demanding tax to tourists to get good comeback to aforesaid issues. However, Himalayan countryside needs lend a hand for new vision on traditional architecture practices, local water management all the way through protection of lakes; and poles apart an eco-friendly efficient sewage and garbage management system. As the Ministry of Environment, Forest and Climate Change has implemented National River Conservation Programme, sub-schemes of Conservation of Natural Resources and Eco-Systems, National Afforestation Programme and Green India Mission, National Mission on Himalayan Studies under Climate Change Program under the Central Sector and Centrally Sponsored Schemes of Government of India earlier. National Mission on Himalayan Studies aims to focusing on conservation of Himalayan ecosystem and sustainable development of the Indian Himalayan Region. The program aims at networking and forging strategic partnerships among relevant Scientific Institutions and stakeholders for enhancing knowledge data base and scientific inputs. As per a report of press Information Bureau, Ministry of Environment, Forest and Climate Change, Govt. of India, 2016; under the centrally sponsored schemes, as per the revised funding pattern from 2015- 16 onwards, the Govt. of India's share is 50% for rest of India and 80% for the North-Eastern states and three Himalayan states i.e. Jammu & Kashmir, Himachal Pradesh and Uttarakhand in environment sector. The share of the Government of India is 60% for rest of India in the schemes related to forestry and wildlife and 90% in respect of North-Eastern states and three Himalayan states.

### **Urbanization**

Rapid urbanization; growing energy demands; environmental degradation; declining agricultural productivity; weak human capital; generating productive jobs; new security threats; and re-positioning India in a changing global order, the new government takes charge at an important policy juncture (Saran, 2019) <sup>[49]</sup>. The states of India which share the Himalayas are also its principal sentinels. The cities in the Himalayan mountainous zones are increasing in size and number. The unmanaged and unchecked urban growth should not be allowed Himalayan region at any cost. The construction of the buildings should be done keeping in mind the local ecosystem, taking into account seismic fragility and the need for aesthetics. To keep check on all these activities, there will be requirement of the establishment of burly regulatory institutions in the urban areas. The metropolitan byelaws should prohibit construction activity in areas without prior approval and certification by regulatory authorities. It

should be totally banned in those areas, which comes in vulnerability zones, areas of rivers bank, springs and watersheds in Himalayan region. It should have to be zero-tolerance in case if not followed strictly. The proper management of natural resources with the help of eco-friendly technologies is the pre-request of any development in the Himalayan regions (Rawat *et al.*, 2010) <sup>[54]</sup>.

### **Conclusion**

The main approaches to Himalayan ecosystem deteriorating challenges are uncontrolled greedy manmade activities towards natural resources. Therefore, it is an urgent and suited time to respond more immediately to causes that since beginning to be seen as threat the climate and wealth of the vulnerable region. Tough the need of present century is the better livelihood and economic growth of the peoples of the Himalayan states definitely; but not at the cost of future of country in terms of environment, climate, biodiversity and beauty of nature. The authors wish to put forward to espouse a substitute model that would uphold economic sustenance of the local people along with endurance of the Himalayas and upcoming life. Thus the new models of development should be in such a way that it would be as per the Himalayan region's ecology and traditional knowledge and culture, to build an economy by local people participation.

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### **References**

1. Acharya PR, Gupta P, Adiga R, Amatya A. The Himalayas: Rethinking the region, reimagining the identities. Himalayan Studies Conf, Georgia State University 2017.
2. Aggarwal M. Five years since Uttarakhand floods: Continued disregard for the environment is an open invitation for more calamities. Mongabay India Newsletter 2018.
3. Akhtar A, Gondhalekar D. Impacts of tourism on water resources in Leh town: Towards an eco-tourism approach. Int. Asso. Ladakh. Studies 2013, P25-37.
4. Ali J, Benjaminsen TA. Fuelwood, timber and deforestation in the Himalayas. Mount Res. Dev 2004;24(4):312-318.
5. Anonymous. Report on Governance for the sustaining the Himalayan ecosystems guidelines and best practices. Ministry of Environment and Forest, New Delhi 2009.
6. Anonymous. National mission for sustaining the Himalayan ecosystem: National action plan on climate change. Department of Science and Technology, New Delhi 2010.
7. Anonymous. Task force 4: Micro flora, fauna, wildlife and animal population. Himalayas Climate Change Portal 2015.

- <http://knowledgeportal-nmshe.in>.
8. Asadzadeh A, Mousavi MSS. The Role of tourism on the environment and its Governing Law. *Elect. J Biol* 2017;13(2):152-158.
  9. Basu S, Singh J, Shrivastava SK, Paliwal A, Chakravartty A. Remembering 2013 Uttarakhand floods 2016, P41497.
  10. Bhushan I, Kumar A, Patel JS, Yadav RP, Singh S, Meena R, Meena SK, Meena VS. The Indian Himalayan Ecosystem as Source for Survival. *Conserv. Agri. Publ. Springer, Singapore* 2016, P367-380.
  11. Briassoulis H, Van Der Straaten J. Tourism and the Environment: An Overview. In: *Tourism and the environment* (Briassoulis H, Van Der Straaten J). *Environ. Assess* 1992;2:1-9.
  12. Chatterjee D. Studies on the endemic flora of India and Burma. *J Royal Asiatic Soc. Bengal. Sci* 1939;5:66.
  13. Chitale V, Behera MD. How will forest fires impact the distribution of endemic plants in the Himalayan biodiversity hotspot? *Biodivers. Conserv* 2019. <https://doi.org/10.1007/s10531-019-01733-8>.
  14. Das A, Ramkrushna GI, Badapmain M, Sarkar D, Layek J, Mandal S, Lal R. Managing soils of the lower Himalayas. *Encyclopedia of soil science*, 3<sup>rd</sup> Edition 2016. <https://doi.org/10.1081/E-ESS3-120053284>.
  15. Dhar U. Himalayan Biodiversity: Action plan. *Himavikas Publ* 1997;10:5.
  16. Faraji RA, Aghajani S. The Relationship between tourism and environment. *Iranian J Tourism Hospital* 2010;1(1):37-48.
  17. Gaston AJ, Garson PJ, Hunter ML. The status and conservation of forest wildlife in Himachal Pradesh, Western Himalayas. *Biol. Conserv* 1983;27(4):291-314.
  18. Ghosh BN, Meena VS, Alam NM, Dogra P, Bhattacharyya R, Sharma NK, Mishra PK. Impact of conservation practices on soil aggregation and the carbon management index after seven years of maize-wheat cropping system in the Indian Himalayas. *Agri. Ecosyst. Environ* 2016;216:247-257.
  19. Gudade BA, Chhetri P, Deka TN, Gupta U, Vijayan AK. Organic cultivation of large cardamom (*Amomum subulatum* Roxb.) in Sikkim. *Popular Kheti* 2013;1(3):4-9.
  20. Huber A. Hydropower in the Himalayan hazardscape: Strategic ignorance and the production of unequal risk. *Water* 2019;11:414. <https://doi.org/10.3390/w11030414>.
  21. Ives JD, Messerli B. The Himalayan region: A geographical overview. In: *The Himalayan dilemma: Reconciling development and conservation*. *Human Dev. Lib* 1989, P340.
  22. Jackson MJ. Livestock in the economy of the Himalayan foothills, Uttar Pradesh, India. *Himalayan Environ. Degrad. Conf. Nainital, U.P* 1993.
  23. Järvan M, Vettik R, Tamm K. The importance and profitability of farmyard manure application to an organically managed crop rotation. *Zemdirbyste. Agri* 2017;104(4):321-328.
  24. Jodha NS. Sustainability issues in the mountain context: Emerging scenario. In: *Workshop on approaches to sustainable development of the Indian Himalaya*. Manali, Himachal Pradesh 1992.
  25. Kulshrestha UC. Threats to Himalayan ecosystem due to long range transport of air pollutants and land use changes. *Curr. World Environ* 2019;14(1):1-2.
  26. Kumar B, Singh S, Gupta GP, Lone FA, Kulshrestha UC. Long range transport and wet deposition fluxes of major chemical species in snow at Gulmarg in North-Western Himalayas (India). *Aerosol Air Qual. Res* 2016;16(3):606-617.
  27. Kuniyal PC, Bisht VK, Negi JS, Bhatt VP, Bisht DS, Butola JS, Sundriyal RC, Singh SK. Progress and prospect in the integrated development of medicinal and aromatic plants (MAPs) sector in Uttarakhand, Western Himalaya. *Environ. Dev. Sustain* 2015;17(5):1141-1162.
  28. Mahapatra SK, Reddy GP, Nagdev R, Yadav RP, Singh SK, Sharda VN. Assessment of soil erosion in the fragile Himalayan ecosystem of Uttarakhand, India using USLE and GIS for sustainable productivity. *Curr. Sci* 2018;115(1):108-121.
  29. Mahat TBS, Griffin DM, Shepherd KR. Human impact on some forest of the middle hills of Nepal. I. Forestry in the context of the traditional resources of the State. *Mount. Res. Dev* 1986;6:223-232.
  30. Mandal S, Mohanty S, Datta KK, Tripathi AK, Hore DK, Verma MR. Internalising Meghalaya towards organic agriculture: Issues and priorities. 14<sup>th</sup> Ann. Conf. Agri. Econ. Res. Asso 2006;19:1-18.
  31. Melese W. Effect of farm yard manure application rate on yield and yield components of lettuce (*Lactuca sativa*) at Jimma Southwestern Ethiopia. *Int. J Res. Grantha* 2016;4(8):75-83.
  32. Milcu Ioana A, Hanspach J, Abson D, Fischer J. Cultural ecosystem services: A literature view and prospects for future research. *Ecol. Soc* 2013;18(3):44.
  33. Moench M, Bandyopadhyay J. People-forest interaction: A neglected parameter in Himalayan forest management. *Mount. Res. Dev* 1986;6:3-16.
  34. Narain S. Himalayas: The agenda for development and environment. *Down to Earth News* 2015, P41486.
  35. Narain S. Training engineers, not Ganga. *Down to Earth News* 2015, P40801.
  36. Negi SS. Himalayan wildlife habitat and conservation. *Indus Publ. Comp. New Delhi* 2007, P145.
  37. Pandey K. PM's climate mission plan for Himalaya yet to take off. *Down to Earth News* 2015, P41431.
  38. Prakash S. How to develop the Himalaya in four easy steps? In: *Action plan for Himalaya*. *Himavikas Occason. Publ* 1993;2:1-3.
  39. Raina VK. Himalayan glaciers: A State-of-Art review of glacial studies, glacial retreat and climate change. *Ministry of Environment and Forest, New Delhi* 2009.
  40. Rao KS, Saxena KG. Sustainable development and rehabilitation of degraded village lands in Himalaya. *Bishen Singh Mahendra Pal Singh Publ, Dehradun* 1994.
  41. Rao RR. Biodiversity in India: Floristic aspects. *Bishen Singh Mahendra Pal Singh Publ, Dehradun* 1994.
  42. Rasekhi S, Mohammadi S. The relationship between tourism and environmental performance: The case of Caspian Sea Nations. *Iranian J Econom. Studies* 2015;4(2):51-81.
  43. Rawat LS, Maikhuri RK, Negi VS, Bahuguna A, Rao KS, Agarwal SK, Saxena KG. Managing natural resources with eco-friendly technologies for sustainable rural development: A case of Garhwal Himalaya. *Int. J Sustain. Dev. World Ecol* 2010;17:423-430.
  44. Salick J, Zhendong F, Byg A. Eastern Himalayan alpine plant ecology, Tibetan ethnobotany and climate change. *Glob. Environ. Change* 2009;16:488-495.

45. Samant SS, Dhar U. Diversity, endemism and economic potential of wild edible plants of Indian Himalaya. *Int. J Sustain. Dev. World Ecol* 1997;4:179-191.
46. Samant SS, Dhar U, Palni LMS. Medicinal plants of Indian Himalaya: Diversity, distribution, potential values, Gyanodaya Prakashan, Nainital 1998.
47. Samant SS, Pant S, Singh M, Lal M, Singh A, Sharma A, Bhandari S. Medicinal plants in Himachal Pradesh, North-west Himalaya, India. *Int. J Biodivers. Sci. Ecosyst. Serv. Manag* 2007;3:234-251.
48. Samant SS, Vidyarthi S, Pant S, Sharma P, Marpa S, Sharma P. Diversity, distribution, indigenous uses and conservation of the medicinal plants of Indian Himalayan region used in cancer. *J Biodivers* 2011;2:117-125.
49. Saran S. Safeguarding the fragile ecology of the Himalayas: Sustainable urbanization in mountain habitats. In: *Policy Challenges 2019-2024. Cent. Policy Res* 2019, P7871.
50. Sathyakumar S, Bashir T. Wildlife of the Himalaya: Conservation issues and the way forward. In: *Mountain ecosystem and man (Arora S et al.). Soil Conserv. Soc. India, New Delhi* 2010, P324-345.
51. Sathyakumar S, Mathur VB, Mondal K, Dasgupta S. Wildlife watch in the Indian Himalayan region. *Curr. Sci.* 2018;114(4):25.
52. Shrestha UB, Gautam S, Bawa KS. Widespread climate change in the Himalayas and associated changes in local ecosystem. *PLoS* 2012;7:36-41.
53. Singh AK, Bordoloi LJ, Kumar M, Hazarika S, Parmar B. Land use impact on soil quality in eastern Himalayan region of India. *Environ. Monit. Assess* 2013. <https://doi.org/10.1007/s10661-013-3514-7>.
54. Singh G, Rawat GS. Ethnomedicinal survey of Kedarnath wildlife sanctuary in Western Himalaya, India. *Indian J Fanam. Appl. Life Sci* 2011;1:35-46.
55. Singh JS. Sustainable development of the Indian Himalayan region: Linking ecological and economic concerns. *Curr. Sci* 2006;90(6):25.
56. Singh R, Upadhyay SK, Rani A, Kumar P, Kumar A. Ethanobotanical study of Subhartipuram, Meerut, Uttar Pradesh, India. II. Diversity and pharmacological significance of shrubs and climbers. *Int. J Pharma. Res* 2020;12(2):383-393.
57. Singh R, Upadhyay SK, Rani A, Kumar P, Kumar A, Sharma P. Ethanobotanical study of Subhartipuram, Meerut, Uttar Pradesh, India. I. Diversity and pharmacological significance of trees. *Int. J Pharma. Res* 2019;11(4):782-794.
58. Singh R, Upadhyay SK, Sunita. Phytodiversity of wild flora from Maharishi Markandeshwar (Deemed to be University), Mullana-Ambala, Haryana, India. *Bull. Pure Appl. Sci* 2018;37B(2):130-136.
59. Singh SP. Himalayan forest ecosystem services. *Cent. Him. Environ. Asso* 2007, P64.
60. TME. Report of the taskforce on mountain ecosystems: 11<sup>th</sup> five year plan. *Environ. Forest Sect. Plan. Comm., Govt India* 2006.
61. Taneja S. Sikkim is 100% organic! Take a second look. *Down to Earth News* 2017, P57517.
62. Tewari VP, Verma RK, Von Gadow K. Climate change effects in the Western Himalayan ecosystems of India: Evidence and strategies. *Forest Ecosyst* 2017;4:13.
63. Verma JP, Jaiswal DK, Meena VS, Meena RS. Current need of organic farming for enhancing sustainable agriculture. *J Clean. Prod* 2015;102:545-547.
64. William M. Deforestation: past and present. In: *Progress in Human Geography* 1989, P176-208.
65. Xu J, Grumbine R, Shrestha A, Eriksson M, Yang X. The melting Himalayas: Cascading effects of climate change on water, biodiversity and livelihoods. *Conserv. Biol* 2009;23:520-530.
66. Zobel DB, Singh SP. Himalayan forests and ecological generalizations. *Bio. Sci* 1997;11:735-745.