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Geographical Society of Central Himalaya

Geographical Society of Central Himalaya

Geographical Society of Central Himalaya (GSCH) was established on 23 March 2021 under the Societies Registration Act No. XXI of 1860, with its headquarters at 51 Nalapani Road, Dehradun. It was founded by Dr. Kamlesh Kumar, a renowned former Professor of Geography at HNB Garhwal University, Srinagar Garhwal. Subsequently, many geographers from the region became its founding members. There are three categories of membership: Fellows, Life Members, and Annual Members.

The Society aims to provide a platform for geography-centered academic interactions among faculty members, scholars, development stakeholders, and government representatives on relevant issues. Since most educational institutions in Uttarakhand are supported by public funds, it is expected that they contribute to society in return. The Society also seeks to improve the academic environment with a strong commitment to Geography as a discipline, while striving for practical applications such as advising the government on issues related to development and environmental conservation.

The Society is publishing a Himalayan Bulletin (this is the first issue). The articles and reports are related to various Himalayan aspects, ranging from sustainable resource management and sustainable development to climate change, disaster management, and culture-based studies.

Since its inception, the Society has been organizing significant national and international events each year, such as World Environment Day, National Tourism Day, Himalaya Day, GIS Day, and International Mountain Day. In addition, at the college level, it conducts activities such as essay competitions and quiz contests.

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In this Volume

Almost six months after publishing Himalayan Bulletin (Vol. 2(1)), we released the new issue, Vol. 2(2), as promised. For this issue, we received 11 papers. However, we have selected six papers, a research communication, and a book review. These papers described different themes ranging from the utilisation of Chir pine needles to the development of Uttarakhand, tourism and its impact on the Himalayan environment, spatial patterns of socio-economic development, rural community health problems, tribal women's participation in agriculture, the natural and cultural significance of the Himalaya, and a book review on 'Exploring the Mystical Himalaya.' We hope that you will enjoy reading these papers and use them for your future research. We also invite you to submit papers for the next issue of the Himalayan Bulletin.

*Vishwambhar Prasad Sati
Rajesh Bhatt*



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Utilisation of Chir Pine (*Pinus roxburghii*) Needles for Green Bioeconomy, Rural Enterprises and Climate-Resilient Development in Uttarakhand

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Abstract

Chir Pine (*Pinus roxburghii*) is the predominant conifer species of the western Himalaya that covers nearly 399,330 ha (16.4%) of Uttarakhand's recorded forest area. These forests generate approximately 1.3 million tonnes of pine needles (*pirul*) each year, with nearly 0.6 million tonnes of surplus available for gainful utilisation after meeting the traditional needs of rural people. Pine needles are highly flammable, a primary factor behind recurring forest fires that reduce biodiversity and forest ecosystem services, increase greenhouse gas emissions, and impose considerable annual fire-suppression costs on the state government. Pine needles contain abundant lignocellulosic biomass, offering significant opportunities as a renewable feedstock for bioenergy generation and advancing a circular bioeconomy. This article brings together recent scientific developments, technological progress, and institutional efforts aiming at industrial utilisation of Chir Pine needles in Uttarakhand and across the western Himalaya. Its important uses include renewable energy generation, biofuels, biochar, activated carbon, pulp and paper, biodegradable packaging materials, fibre composites, textiles, handicrafts, and a range of other value-added products. In this article, we emphasise the sustainable use of Chir Pine needles to reduce fuel loading on the forest floor and minimise forest fire risks, promote decentralised rural enterprises, improve climate resilience, and strengthen ecosystem services. The article also highlights prevailing challenges in biomass harvesting, transportation, technology transfer, commercialisation, and market expansion. The article concludes that combining scientific research, decentralised processing systems, community engagement, and enabling policy support can convert pine needle biomass from a major forest fire hazard into a valuable resource for green industries, climate change mitigation, and sustainable mountain development.

Keywords: Chir Pine (*Pinus roxburghii*); Pine Needles (*Pirul*); Forest Biomass; Circular Bioeconomy; Bioenergy; Rural Enterprises; Climate Resilience; Uttarakhand.

Introduction

Forests of the Indian Himalayan Region (IHR) provide a wide array of ecosystem services that benefit both mountain inhabitants and downstream populations by conserving biodiversity, regulating soil and water resources in watersheds, sequestering carbon, and sustaining rural livelihoods (Singh & Singh, 1992). However, these ecologically sensitive, fragile mountain landscapes are threatened by climate change, frequent forest fires, invasive alien species, and land degradation, which reduce ecosystem services and underscore the urgent need for sustainable bio-resource use and climate-resilient management approaches (FSI, 2023; IPCC, 2022).

Chir Pine (*Pinus roxburghii* Sarg.) is one of the most economically important and dominant forest-forming conifer tree species of the Western Himalaya (Fig. 1). In the mountains of Uttarakhand within the altitudinal range of 1,000–1,800 m, it extends over approximately 4,000 sq km, accounting for nearly 16% of the state's recorded forest area (FSI, 2023). It is a drought-tolerant species that can thrive under inhospitable environmental conditions, enabling it to spread across large tracts of the Middle Himalaya. The resin extracted

from this tree yields oleoresin, an important raw material for the resin-based industry. Oleoresin is processed into rosin and turpentine, which are widely used in manufacturing paper, paints, adhesives, pharmaceuticals, rubber products, and synthetic resins (Nimkar & Sharma, 2008). In Uttarakhand, resin production makes a substantial contribution to the state's economy (Uttarakhand Forest Department, 2016).



Fig. 1. Chir Pine (*Pinus roxburghii*) forest in Uttarakhand; Interior view of the forest.

Pine trees are widely used for furniture making as they have a clear cylindrical bole and are relatively easy to saw and work. In addition, various parts of the tree have traditional uses such as stems serving as poles for climbing vegetables; leaves are used for thatching, cattle bedding, and broom making; seeds are nutritious; cones are used for decorative items; and bark is used as fuel by blacksmiths (Negi et al., 2021). This early-successional species has a tremendous capacity to grow and regenerate on soils of poor fertility and low moisture, unlike the socially valued Oak (*Quercus* spp.). However, the bad aspect of this species is that the huge quantities of its needles dropped on the forest floor (locally called *Pirul*) are highly inflammable due to the presence of oleoresin that catches fire and make colossal loss every year to the forest wealth of Uttarakhand (Fig. 2). For example, the 1999 forest fires, among the largest recorded in Uttarakhand, affected approximately 5,086 km² (22.6%) of forest area, causing an estimated loss of ₹50 lakh as per the set norms of the Forest Department (Negi, 2019). Negi et al. (2025) estimated the loss of forest wealth due to forest fires in Uttarakhand at a mean value of ₹1,30,387/ha (range = ₹9,595–₹3,52,752/ha), which is about 65–90 times higher than previously reported. This is a major ecological concern in the Western Himalayan region.

Uttarakhand is estimated to produce approximately 0.96–1.66 million tonnes of pine needles every year. This biomass could produce 1,035–1,791 GWh of electricity (approximately 118–205 MW) through thermochemical conversion, making it an important decentralised renewable energy resource for mountain communities (Kala & Subbarao, 2017). From a biochemical perspective, pine needles constitute a valuable lignocellulosic feedstock containing about 45% carbon, 0.93% nitrogen, 6.5% hydrogen and 0.13% sulphur, with a carbon-to-nitrogen ratio of approximately 51, making them suitable for producing bioenergy, biochar, activated carbon, fibre products and biodegradable materials (Gupta et al., 2024).



Fig. 2. Pine needles (*Pirul*) collected from the forest, and *Pirul* being carried away by women

Despite their economic potential, accumulated pine needles become highly combustible during the dry summer season because of their high resin content and slow decomposition. Unlike broad-leaved litter, pine needles may persist on the forest floor for more than two years, creating a continuous fuel layer that substantially increases fire intensity and spread under conditions of high temperature, low humidity and prolonged drought (Tiwari & Tiwari, 2001).

Forest fires have become one of Uttarakhand's most serious environmental challenges. Since the formation of the State in 2000, more than 44,500 ha of forests have reportedly been affected by fire (Negi, 2018). During April 2024 alone, the Forest Survey of India recorded 3,338 forest fire alerts, highlighting the increasing frequency and severity of fire events (FSI, 2024). Studies during the COVID-19 lockdown further indicated that anthropogenic activities remain a major cause of forest fires in the region. Recurring fires degrade forest ecosystems by reducing natural regeneration, altering nutrient cycling, promoting invasive species such as *Lantana camara* and *Ageratina adenophora*, and accelerating soil erosion (Singh et al., 1984). They also impair watershed functions and contribute to declining spring discharge in Himalayan catchments (Negi & Pant, 2025). In addition, forest fires release substantial quantities of carbon dioxide, methane, carbon monoxide and black carbon, thereby reducing ecosystem carbon stocks and contributing to climate change. For example, the 2016 Uttarakhand forest fires increased atmospheric carbon monoxide concentrations by nearly 45% above the five-year average, while repeated burning has caused significant losses of above-ground biomass carbon in Chir Pine forests (Thakur et al., 2019; Bargali et al., 2024).

The economic consequences are equally significant. Assessments coordinated by the Indian Council of Forestry Research and Education (ICFRE) estimated direct losses from forest fires ranging from ₹9,595 to ₹352,752 per hectare, with an average loss of about ₹130,387 per hectare (ICFRE, 2021; Negi et al., 2025). These estimates exclude the much larger indirect losses associated with biodiversity conservation, watershed protection, tourism, carbon sequestration and other ecosystem services. Although considerable investments are made annually in fire lines, fire watchers and suppression measures, these approaches address the symptoms rather than the underlying accumulation of combustible biomass.

Sustainable utilisation of Chir Pine needle biomass therefore offers an opportunity to convert a recurring forest fire hazard into a valuable renewable resource. Recent advances in biomass conversion technologies have demonstrated the feasibility of producing briquettes, pellets, bio-oil, biochar, activated carbon, fibre composites, paper, biodegradable packaging, textiles and handicrafts from pine needles. These technologies not only reduce forest fuel loads but also support decentralised enterprises, women-led livelihoods and green manufacturing. Recognising this potential, the Government of Uttarakhand introduced the Policy for Power Generation from Pine Leaves and Other Biomass (2018) to promote organised biomass collection and decentralised renewable energy through the Forest Department, Uttarakhand

Renewable Energy Development Agency (UREDA), Van Panchayats, Gram Panchayats, Self-Help Groups, and private entrepreneurs. As biomass processing and circular bioeconomy approaches advance, opportunities now extend beyond electricity generation to diversified value-added products, carbon management, and climate-resilient rural development.

This review synthesises current scientific knowledge, technological developments and institutional experiences related to industrial utilisation of Chir Pine needles in Uttarakhand and the western Himalaya. The article explores emerging value-added industrial uses of Chir Pine needle biomass (*Pirul*), synthesises existing R&D knowledge, and recommends policy measures to promote a sustainable circular bioeconomy through efficient utilisation of Chir Pine needles and tree products.

Emerging Industrial Applications of Chir Pine Needles

Table 1 summarises the major industrial applications of Chir Pine needles reported by different R&D organisations, government departments, universities, and community-based enterprises; it indicates that *Pinus roxburghii* needles, as a renewable lignocellulosic biomass, have been utilised beyond their traditional uses. Pine needles, rich in cellulose, hemicellulose, and lignin, can be converted into a wide range of bio-based products through thermochemical, biochemical, and mechanical processes. Such utilisation pathways support a circular bioeconomy by converting Pine leaf litter into value-added products, reducing waste and dependence on fossil resources, and also mitigating forest-fire risks. Thus, it presents a significant opportunity to contribute to climate change mitigation.

Table 1: Industrial Utilisation of Chir Pine Needles (*Pinus roxburghii*): Major Products, Technologies and Key Institutions

Industrial Category	Process and Major Products	Representative Agencies / References
Renewable Energy	Direct combustion, briquetting, palletization and gasification for production of briquettes, pellets, producer gas, heat and electricity	Govt. of Uttarakhand (2018); Kala & Subbarao (2018); UREDA (2023); Jain & Choudhry (2021); https://avani-kumaon.org)
Biofuels and Biorefinery	Pyrolysis, hydrothermal liquefaction and biochemical conversion for bio-oil, bioethanol, syngas and green chemicals	Slathia et al. (2020); Singh et al. (2021); CSIR-IIP, Dehradun (2021);
Biochar and Activated Carbon	Slow pyrolysis and carbonization for biochar, activated carbon, adsorbents and soil amendments	Kumar et al. (2020); Azad et al. (2022); Rana et al. (2023) / GBPUAT, Pant Nagar
Paper and Pulp Industry	Chemical and mechanical pulping for handmade paper, stationery, packaging paper and molded fiber products	Kumar (2020); Negi et al. (2021); FRI, Dehradun / GBPNIHE, Almora
Textiles and Natural Fibers	Fiber extraction, retting and blending for yarn, fabrics, carpets, mats, home furnishings and eco-textiles	Kumar et al. (2021); FRI / Uttarakhand Bamboo and Fiber Development Board (2021); NITRA, Ghaziabad (2022)
Wood Composites and Building Materials	Compression molding and resin bonding for particle boards, medium-density fiber boards (MDF), insulation panels and composite boards	Singh & Vinay (2025); Pant Nagar University; ICFRE-FRI, Dehradun (2023)

Biodegradable Packaging and Bioplastics	Fiber molding and biodegradable composite technology for trays, disposable tableware, food containers and packaging materials	Chauhan et al. (2018); Gaikwad et al. (2021); Wali (2019); NIFT, Jaipur / IIT, Roorkee
Environmental Applications	Preparation of biosorbents, activated carbon and filtration media for wastewater treatment, heavy metal adsorption and air purification	Choudhary et al. (2020); Rana et al. (2023); Univ. of Petroleum & Energy Studies, Dehradun; JNU, New Delhi
Agriculture and Soil Improvement	Pyrolysis, composting and mulching for biochar, compost, soil conditioner, moisture conservation and carbon sequestration	Kumar et al. (2009); Choudhary et al. (2020); Nain et al. (2023); Jaiswal (2025); GBPNiHE, Almora / GBPUAT, Pant Nagar/ Estelar Enterprises, Almora
Essential Oils and Oleochemicals	Steam distillation and solvent extraction for pine oil, terpenes, resin derivatives, fragrances and pharmaceutical intermediates	FRI (2020); Gupta et al. (2026); UCOST, Dehradun
Handicrafts and Cottage Industries	Manual weaving, stitching and value addition for baskets, mats, trays, flower pots, decorative items, jewelry and household articles	GBPNiHE (2025), Almora/FRI-ICFRE, Dehradun (2021), UBFDB, Dehradun (2021)/ Pirul Handicrafts, Champawat; Maa Dunagiri Pirul SHG, Dwarahat, Almora; Mount Valley Development Association, Tehri Garhwal; Dhuri Foundation, Nainital
Carbon Management and Circular Bioeconomy	Sustainable biomass utilization, biochar production, substitution of fossil-based products and forest fuel-load reduction contributing to carbon sequestration and ecosystem services	IPCC (2022); Govt. of Uttarakhand (2018); Rana et al. (2023); Negi & Mehta (2026)

Renewable energy remains the most established application of Chir Pine needles. Their relatively high calorific value, seasonal availability and widespread distribution make them suitable for briquetting, pelletization, gasification and decentralised electricity generation. These technologies simultaneously reduce forest fuel loads, provide clean energy and generate employment through biomass collection and processing (Kala & Subbarao, 2018; Govt. of Uttarakhand, 2018). The State's biomass policy has further encouraged decentralised power generation and village-level biomass enterprises.

Recent advances have expanded the utilisation of Chir Pine biomass beyond conventional energy applications toward integrated biorefinery systems. The thermochemical conversion technologies, including pyrolysis and hydrothermal liquefaction, can produce bio-oil, syngas, biochar, and value-added chemicals, while biochemical conversion offers potential for biofuels and other bio-based products (Slathia et al., 2019; CSIR-IIP, 2021). UCOST, Dehradun, has also supported research and technology demonstration on pine-needle utilisation for bioethanol production (UCOST, 2007). Integrating these conversion pathways can improve biomass utilisation efficiency, diversify product streams, enhance resource recovery, and strengthen the overall economic viability of Chir Pine biomass.

Biochar preparation from Chir Pine biomass is emerging as a promising climate-smart technology. Biochar derived from pine needles can improve soil fertility, enhance water-holding capacity, and facilitate long-term carbon sequestration. Furthermore, activated carbon

produced from pine biomass has demonstrated considerable potential for wastewater treatment through the effective adsorption of diverse environmental pollutants (Kumar et al., 2020; Azad et al., 2022; Rana et al., 2023). These applications offer a dual benefit by contributing to environmental restoration while promoting the sustainable utilisation of forest biomass resources.

The utilisation of Pine biomass in the pulp and fibre sector offers yet another considerable scope for value addition. Owing to their relatively high cellulose content, Pine needles can be converted into handmade paper, stationery, multifiber products, and biodegradable packaging materials. Technologies developed by GBPNIHE, Almora, Forest Research Institute, Dehradun, and other research institutions have demonstrated the technical feasibility of using Pine needle biomass as an alternative source for producing environment-friendly handmade paper and other value-added products (Kumar, 2020; Negi et al., 2021).

Pine fibers also offer considerable potential for developing biodegradable composites, insulation panels, and engineered boards that can partially substitute synthetic materials in sustainable construction. However, further R&D is needed to optimise fiber extraction, processing, and product development for these applications. Advances in fibre-processing technologies have also enabled the production of textiles, carpets, mats, decorative articles, and other household products. Blending pine fibres with cotton, wool, or bamboo can improve product properties while creating opportunities for women-led enterprises and decentralized rural industries (Kumar et al., 2021; UBFDB, 2021). Community-based value addition has further demonstrated the socio-economic potential of pine biomass utilisation in Uttarakhand. Women Self-Help Groups and local organizations across Uttarakhand are successfully producing baskets, trays, mats, decorative articles, and other household products from pine needles, generating supplementary income while systematically *Pirul* from forests that is highly vulnerable to fire (GBPNIHE, 2025; FRI-ICFRE, 2021; UBFDB, 2021).

In addition to needle biomass, Chir Pine contains commercially valuable volatile compounds, including α -pinene, β -pinene, and limonene, which constitute important components of Pine oil and have wide applications in the fragrance, pharmaceutical, and specialty chemical industries. Although large-scale commercial extraction of Pine oil remains limited, integrating Pine oil recovery with existing biomass-processing technologies could improve resource-use efficiency, diversify value-added products, and enhance the economic viability and profitability of biomass-based enterprises (FRI, 2020; Gupta et al., 2026).

Overall, industrial utilisation of Chir Pine needles has progressed from conventional biomass energy to diversified applications in green materials, environmental technologies and rural enterprises. Nevertheless, most technologies remain at pilot or small-commercial scale. Scaling up decentralised processing, improving market linkages, and strengthening research–industry–community partnerships will be essential to establish a sustainable pine biomass economy in Uttarakhand.

Sustainable Utilisation of Chir Pine Needles for a Circular Bioeconomy in Uttarakhand

The increasing global emphasis on renewable bio-resources is driving a transition from conventional linear production systems towards circular bioeconomy models that maximise resource efficiency, minimise waste, and reduce dependence on fossil fuels. In this context, biomass is increasingly recognised as a key resource for generating renewable energy and bio-based materials within circular production systems (Sherwood, 2020). Accordingly, Chir Pine needles should no longer be viewed merely as hazardous forest litter, but as a valuable

lignocellulosic biomass with substantial potential for renewable energy generation, green manufacturing, carbon management, and the development of decentralised rural enterprises.

Given Uttarakhand's extensive Chir Pine forests, recurrent forest fires, and dispersed mountain settlements, this approach is particularly relevant to the state, as these conditions provide a strong basis for decentralised and locally integrated biomass utilisation. Organised collection and scientific valorisation of Pine needles can simultaneously reduce forest fuel loads, generate rural employment, diversify forest-based livelihoods, and contribute to climate change mitigation. Future initiatives in Uttarakhand should prioritise integrated biomass utilisation through diversified and value-added value chains, rather than dependence on a single end-use product, in alignment with the state's *Policy for Power Generation from Pine Leaves and Other Biomass, 2018*.

From Forest Residue to a Strategic Bioeconomy Resource

Pine needles are a lignocellulosic biomass resource with strong potential to replace fossil-derived raw materials in energy, packaging, textiles, chemicals, construction, and other value-added applications because of their cellulose, hemicellulose, and lignin content (Tewari, 1994; Gupta et al., 2024). Future utilisation of Pine biomass should therefore adopt a cascading approach, converting biomass progressively into higher-value products rather than limiting its use only to fuel. In Uttarakhand, decentralised village-level processing can reduce transportation costs, generate local employment, and strengthen rural value chains. The pine-needle processing facility established by GBPNIHE, Almora, which produces briquettes, handmade paper, and other products through community participation and public-private partnerships, demonstrates the feasibility of this approach (Negi et al., 2021; GBPNIHE, 2025). A UCOST-GBPNIHE-AGNI technology showcase in Champawat further demonstrated pine-needle-based briquettes and paper products, highlighting opportunities for decentralised value addition. Scaling such initiatives across Chir Pine-dominated areas could strengthen livelihoods, resource efficiency, and biomass-based enterprises in Uttarakhand.

Advanced Biomass Conversion Technologies

Although briquetting and biomass-based power generation remain important utilization pathways, recent technological advances have expanded the scope for producing a diverse range of higher-value products. Advanced thermochemical processes such as gasification, torrefaction, fast pyrolysis, and hydrothermal carbonisation can convert pine biomass into bio-oil, syngas, biochar, and other renewable materials, offering greater economic value than conventional fuel-based applications (Bhattacharya et al., 2022). Future research should therefore focus on improving conversion efficiencies, reducing production costs, and developing compact, decentralised processing systems adapted to mountain conditions. Integrating renewable energy production with modern biorefinery approaches can enhance resource-use efficiency, maximise biomass valorisation, and strengthen the long-term economic viability of biomass-based enterprises.

Biochar, Green Materials, and Climate-Smart Agriculture

Biochar has emerged as a promising value-added product from Chir Pine needles because of its potential applications in soil amendment, carbon sequestration, and sustainable management of pine-needle biomass (Nain et al., 2023). Controlled pyrolysis of Chir Pine

needles produces a stable, carbon-rich biochar with potential applications in soil improvement, water purification, and long-term carbon sequestration. The porous structure and surface properties of pine-derived carbon materials facilitate contaminant adsorption from water and other aqueous systems. Research at G.B. Pant University of Agriculture & Technology, Pantnagar, demonstrated that Chir Pine leaves can effectively remove heavy metals such as Cr(VI), Cu(II), Fe(II), and Zn(II) from industrial effluents, highlighting their potential for low-cost water and wastewater treatment (Tewari & Vivekanand, 2013). Such applications could support the development of decentralised and locally appropriate water-purification technologies for mountain communities. Beyond biochar, pine needles also offer opportunities to produce biodegradable packaging materials, fibre composites, insulation panels, and other environmentally friendly products that can partially replace petroleum-derived materials.

Integration with Carbon Markets and Payment for Ecosystem Services

An emerging opportunity for Chir Pine biomass utilisation lies in carbon markets and ecosystem-based financing. Sustainable collection and utilization of pine needles can support climate mitigation by reducing forest-fire risks, substituting fossil-based fuels and materials, and enhancing long-term carbon storage through biochar and durable bio-based products, consistent with circular bioeconomy principles and nature-based solutions (IPCC, 2022).

Initial studies on Van Panchayat forests of Uttarakhand have demonstrated the feasibility of quantifying carbon stocks and ecosystem services under community forest management following IPCC protocols (Negi & Mehta, 2026). Building on these efforts, standardised MRV protocols could quantify biomass availability, avoided fire emissions, biochar-based carbon sequestration, and benefits from fossil-product substitution. Robust carbon accounting would strengthen participation in voluntary carbon markets, Payment for Ecosystem Services (PES), and emerging climate-finance mechanisms, while generating additional income for mountain communities.

Community Participation, Women Empowerment and Rural Enterprises

The long-term sustainability of a Chir Pine-based circular bioeconomy will depend largely on active participation of local communities, particularly Van Panchayats, Self-Help Groups, Farmer Producer Organisations, and rural entrepreneurs. Uttarakhand possesses one of India's strongest community forestry systems, providing an institutional foundation for organised pine needle collection, decentralised processing and value-added enterprises.

Women already play a central role in forest resource management and forest-based livelihoods across the Himalayan region. Strengthening women-led enterprises in pine fiber processing, handicrafts, biodegradable packaging and other value-added products can diversify household incomes while reducing forest fuel loads. Successful initiatives supported by the Uttarakhand Bamboo and Fibre Development Board (UBFDB), GBPNIHE, the Forest Research Institute (FRI), and community organisations have demonstrated the technical and commercial feasibility of such enterprises (Kumar et al., 2021; UBFDB, 2021; GBPNIHE, 2025). Future efforts should focus on entrepreneurship development through skill enhancement, common facility centres, product design, branding, digital marketing and improved access to institutional finance. Linking producer groups with tourism, handicraft markets, e-commerce platforms and green procurement programmes would further improve market access and enterprise sustainability. Such community-based value chains can

simultaneously support livelihood enhancement, forest conservation and climate resilience (Agrawal, 2001).

Future Innovation Priorities

Although considerable technological progress has been achieved, several priority areas require further research and innovation before Chir Pine biomass utilisation can be scaled up commercially. Future research should prioritise: (1) GIS-, remote sensing- and AI-based assessment of pine biomass resources and digital supply-chain management. (2) Development of efficient technologies for biomass collection, storage, densification and decentralised processing under Himalayan conditions. (3). Techno-economic analysis and life-cycle assessment of alternative utilisation pathways. (4). Production of advanced bio-based materials, including nanocellulose, engineered composites, biodegradable packaging and speciality chemicals. (5). Standardised MRV protocols for carbon accounting, carbon markets and Payment for Ecosystem Services. (6). Stronger collaboration among UCOST, FRI, CSIR-IIP, GBPNiHE, universities, industries, Van Panchayats and private entrepreneurs to accelerate technology transfer and commercialisation. These priorities will strengthen innovation, improve industrial competitiveness and position Uttarakhand as a leader in sustainable mountain bioeconomy development.

Research Gaps and Future Needs

Although significant progress has been made in developing technologies for the utilization of Chir Pine (*Pinus roxburghii*) needles, most applications remain confined to laboratory studies, pilot-scale demonstrations or small community enterprises. The large-scale commercialization of Chir Pine biomass is constrained by fragmented supply chains, difficult mountain terrain, seasonal raw-material availability, limited processing infrastructure, and inadequate market linkages. Addressing these challenges is essential for developing a viable and sustainable circular bioeconomy based on Pine biomass in Uttarakhand.

Future priorities should therefore focus on efficient biomass supply systems, integrating scientific collection, storage, densification, and transportation with GIS, remote sensing, and digital inventories to ensure reliable feedstock for decentralised processing. Techno-economic, life-cycle, and standardised MRV assessments should guide technology selection, investment, and carbon accounting, including avoided fire-generated CO₂ emissions, biochar sequestration, and fossil-material substitution, thereby facilitating access to carbon markets, PES, and climate finance. Technological advancement should promote integrated biorefineries that convert Pine biomass into multiple high-value products, including renewable energy, biochar, activated carbon, fibres, essential oils, and green chemicals. Product standardisation, quality assurance, market development, and stronger collaboration among research institutions, industry, government, and communities are essential for technology transfer and commercialisation. Business incubation, common processing facilities, and skill development can further position Chir Pine biomass as a sustainable resource for green industries, rural livelihoods, and climate-resilient development in Uttarakhand.

Policy Perspectives and Roadmap for Utilisation of Chir Pine Needles in Uttarakhand

Uttarakhand's forests represent a vast yet underutilized renewable biomass resource, with nearly 399,330 ha under Chir Pine and an estimated 1.3 million tonnes of pine needles

generated annually, offering significant potential for green manufacturing, renewable energy generation, value-added enterprises, and sustainable rural livelihoods (Uttarakhand Forest Department, 2016; FSI, 2023). While the *Policy for Power Generation from Pine Leaves and Other Biomass* (2018) established an important foundation for biomass-based power generation, the next phase of policy development should move beyond energy-centric applications toward diversified, higher-value utilisation within a circular bioeconomy framework.

The following strategic priorities are recommended: (i). Diversification of Biomass Utilisation: Expand utilisation beyond electricity generation to include biochar, activated carbon, fibre composites, biodegradable packaging, engineered wood products, green chemicals and other high-value bio-based products. (ii). Strengthening Biomass Supply Chains: Establish village-level collection centres, biomass aggregation systems and decentralised preprocessing facilities for baling, briquetting, fibre extraction and biochar production to improve raw material availability while reducing transportation costs. (iii). Technology Commercialisation: Promote technology transfer through collaboration among UCOST, FRI, CSIR-IIP, GBPNIHE, IIT Roorkee, universities and private industries. Strengthen business incubation, pilot-scale demonstrations, and product certification to accelerate commercialisation. (iv). Community-Based Enterprise Development: Engage Van Panchayats, Self-Help Groups, producer organizations and rural entrepreneurs in biomass collection, processing and value addition. Place particular emphasis on women-led enterprises through skill development, concessional finance, branding, and digital marketing. (v). Carbon Finance and Ecosystem Services: Develop standardized MRV protocols for avoided fire emissions, biochar carbon sequestration and ecosystem service valuation to facilitate participation in voluntary carbon markets and Payment for Ecosystem Services. (vi). Monitoring and Adaptive Governance: Establish an integrated monitoring framework for biomass collection, enterprise development, forest-fire reduction, employment generation and environmental benefits to support evidence-based policy implementation. Adoption of these measures would transform Chir Pine biomass from a seasonal forest management problem into a strategic resource supporting renewable energy, green industries, climate mitigation and sustainable mountain livelihoods.

Conclusion

Chir Pine (*Pinus roxburghii*) needle biomass is one of the largest underutilised renewable resources in the western Himalaya and, rather than being viewed solely as a major forest-fire hazard, should be recognised as a valuable lignocellulosic feedstock for renewable energy, bio-based materials, carbon sequestration, and decentralised rural enterprises. Recent advances in biomass conversion technologies offer significant opportunities to transform Chir Pine biomass into high-value products, including briquettes, pellets, biochar, activated carbon, paper, biodegradable packaging, fibre composites, textiles, and handicrafts. Such diversified utilisation can reduce the accumulation of inflammable Pine needles on the forest floor and avoid forest fire risk while generating employment, strengthening rural livelihoods, and enhancing ecosystem resilience. Realising this potential requires coordinated investment in R&D, technology transfer, entrepreneurship, efficient supply chains, and market development, with active participation of the Forest Department, Van Panchayats, women's SHGs, and R&D institutions. Integrating biomass utilization with carbon accounting, voluntary carbon markets, and PES can further support sustainable forest management and climate action. Within a circular bioeconomy framework, Uttarakhand can transform Chir Pine biomass into a strategic

resource for green growth, climate resilience, and sustainable mountain livelihoods, while providing a replicable model for the wider Indian Himalayan Region and contributing to India's Nationally Determined Contributions (NDCs) on climate action.

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Article**Assessment of Development in Uttarakhand (2000-2025)**

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Abstract

Uttarakhand, a newly born Himalayan state, exhibits some unique physico-cultural peculiarities and hence needs special attention for its development. This state is now completing its twenty-five years of existence. This paper assesses the degree of change in the state's socio-economic scenario over these twenty-five years. Using data from different sources, the study assessed the degree of change in the state so far. The study concluded that the state has changed significantly, but it remains below local expectations. Although female participation in various state activities has increased significantly, overall youth unemployment remains unsolved. Therefore, the state needs more infrastructure, sound and area-oriented execution of government policies, and participation from all sections of rural people as per norms, etc. The state really needs qualitative, not merely quantitative, development.

Keywords: Campaign; Sweet Revolution, Aatmanirbhar Bharat, Equaculture, Gender Parity Index (GPI), Logistic Park, Gross Domestic Product (GDP), Social Progress Index (SPI).

Introduction

After repeated campaigns demanding a separate state, Uttarakhand was formed as a hill state, carved out of Uttar Pradesh. About 86.07% of the state's area is mountainous, and the remaining 13.93% is covered by plains, including the Bhabar, Tarai, and a small part of the Upper Ganga Plain. Because of its physico-cultural and socio-economic peculiarities, this region deserves special attention within Uttar Pradesh. Ultimately, the people of Uttarakhand demanded a separate state, which was formed on 9th November, 2000. This year (2025), the state completes 25 years of its existence. Considering the overall socio-economic changes in this newly formed state, an assessment of its achievements has been conducted to determine whether the state is developing in line with the mountain environment and the expectations of the hill people. Although the state's socio-economic scenario has changed over these 25 years, it has not met people's expectations. Possible reasons for the slow development include: less investment in education and health care; Lack of basic infrastructure for the development of the state; High level of corruption and poor governance; Dependency on only one source of livelihood; Lack of skilled labourers; Changing political administration and slackness towards development; To some extent, revengeful attitude among political parties.

Materials and Methods

In the present assessment, changes in land-use structure, agriculture and innovation, progress in horticulture and allied sectors, development of animal husbandry with dairy and fisheries, industrial development, and changes in infra-structural facilities (viz. transportation, education, health, and social upliftment, etc.) have been considered. To assess the changes so far made in the state, a number of socio-economic data collected from different sources, particularly state statistical diaries, records from the Revenue Commissioner, Uttarakhand Economics Surveys (2021-22 to 2023-24), Directorate of Industries, Agriculture, Horticulture, Animal Husbandry, etc., have been taken. In addition, the state government's decisions on new schemes for the state's upliftment have also been incorporated. All these data have been

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analysed to determine the degree of change over 5 to 10 years, as well as from the state's formation to the present.

Change in Land use: Discussion and Results

At the time of the state's formation, the total net-sown area was 7,69,944 hectares, accounting for 12.57% of the total reporting area. The net-sown area has steadily decreased, viz. 12.37% (2007-08), 11.72% (2011-12), 10.65% (2016-17), and 9.35% (5,93,686 ha) in 2021-22. Likewise, the more-than-once-sown area, which was 4,55,612 ha or 7.43% in 2000-01, also decreased to 5.91% in 2021-22. Possible reasons include lower production due to old traditional farming patterns, as well as a shift of the population to other occupational sectors. Therefore, the area under barren and fallow land shows an increasing trend (Table 1).

Data, from the beginning year of the state to 2021-22, clearly show changes in the main land use patterns of the state: under forests 61.14% (2002-03), 62.51% (2021-22), usar and not suitable for agriculture 5.51% (2002-03), 4.16% (2021-22), land under bushes and orchards 4.44% (2002-03), 6.12% (2021-22), land other than agricultural uses 2.68% (2002-03), 3.19% (2021-22) and net-sown area 13.38% (2002-03), 9.89% (2021-22). Notably, in the hill districts, overall net-sown area was 10.27% in 2002-03, while in 2021-22 it decreased to 6.38%. Uttarkashi is the only district that shows a 0.10% increase in net sown area in 2021-22 compared with 2002-03. Net sown area in both the plain districts also shows a decreasing trend (Udham Singh Nagar 5.67% and Haridwar 6.03 per cent).

Table 1: District-wise change in land use within the interval from 2002-03 to 2021-22 in the state (+/- in %)

Name of District	Under forest	Usar and not suitable for agri.	Under bushes and orchards etc.	Other than agricultural uses	Net sown area	Reported area (Ha)
Uttarkashi	+0.03	+0.39	-0.07	+0.08	+0.10	8,12,689
Chamoli	-0.03	+8.10	+11.96	+1.00	-0.16	5,51,764
Tehri Garhwal	-20.32	-0.04	+0.70	-0.91	-2.60	4,85,517
Pauri Garhwal	+0.32	+0.19	-4.12	+0.33	-7.47	6,69,055
Dehradun	+0.59	+5.48	+0.60	+0.70	-4.36	3,63,018
Rudraprayag	+0.41	+0.46	+1.10	+1.09	-2.29	2,34,796
Pithoragarh	+22.35	+2.19	-1.09	-0.86	-6.78	7,46,734
Almora	+0.10	-0.20	+2.76	+0.07	-5.71	4,64,942
Nainital	-0.32	-0.13	+0.91	+0.91	-2.30	4,08,087
Bageshwar	+1.39	-0.04	+4.05	+0.10	-0.67	2,07,902
Champawat	+2.29	-0.78	-1.93	+0.11	-3.21	2,33,225
Hill Districts Total	+2.25	-0.11	+1.12	+0.08	-3.89	54,77,729
Udham Singh Nagar	-0.01	+0.03	-0.17	+3.56	-5.67	2,79,839
Haridwar	+3.14	+0.34	+0.18	+13.99	-6.54	2,43,985
Plain Districts Total	+1.53	+0.16	Nil	+8.73	-6.03	5,23,824
Uttarakhand	+2.37	-1.35	+1.68	+0.51	-3.49	60,01,583

Change in Agriculture, Production and Innovation

Mountain agriculture mainly depends on the size and geographical location of agricultural holdings. Therefore, before discussing agricultural patterns, production, and innovation, this section presents changes in agricultural holdings from the formation of the

state to the latest survey period (2015-16). In 2000-2001, the total number of agricultural holdings was 8,90,667, of which 70.5% had less than 1.0 ha of area (marginal holdings). According to the 2015-16 survey, the number of agricultural holdings in the state was 8,81,305 (a decrease of 9,362 holdings), of which 74.78% had less than 1.0 ha. In Uttarakhand, the total area of agricultural holdings was 8,43,450 ha in 2000-2001, with 28.7% marginal, 26.2% small, and 25.2% semi-small holdings. Now, according to the 2015-16 survey, the total area of agricultural holdings is 7,47,320 ha, with 37.93% marginal, 27.60% small and 20.8% semi-small holdings. Over these fifteen years, the area under marginal and small holdings increased by 26,422 ha (5.39%), while the area under semi-medium, medium, and big holdings decreased by 1,22,563 ha (47.57%).

In this state, out of the total sown area, the maximum area (29%) is covered by wheat cultivation, followed by paddy (24%), sugarcane (10%), Mandua (8%) and Pulses (6%). As far as food grain production is concerned, at the beginning of the state (2000-2001), 9,85,000 ha was under food grain cultivation, with production of 16,47,000 MT. However, this area subsequently declined to about 7,53,000 ha under food grain cultivation in 2022-23. However, despite the declining trend in area, foodgrain production increased due to the introduction of high-yielding variety (HYV) seeds, the use of high-quality fertilisers and pesticides, and increased irrigation facilities. As a result, per-hectare foodgrain production rose from 1.672 MT in 2000-2001 to 2.25 MT in 2022-23. The productivity of some crops within the period of ten years (2011-12 to 2020-21) increased as Paddy 32.5%, Maize 38.0%, Coarse grains 10.9%, Urad 31.7%, Kulath 21.1%, Taur 75.1%, Ramdana 166.0% and Mandua 4.4 percent.

In 2000-01, net irrigated area in the state was 3,43,608 ha and gross irrigated area was 5,37,439 ha, while in 2021-22, net and gross irrigated area recorded 3,15,470 ha and 5,47,759 ha, respectively. Thus, net irrigated area decreased by 28,138 ha (8.92%), while gross irrigated area increased by 10,320 ha (1.88%). Here, canals and tube wells are the main sources of irrigation. In 2000-01, canals irrigated 29.30% of the area, and tube wells irrigated 55.8%. However, canal irrigation decreased by 8.4% (to 20.90%), while tube-well irrigation increased by 15.86% (to 71.66%).

In Uttarakhand state, more than 90% of agricultural holdings are marginal and small; hence, mechanised farming is not possible. However, improving the quality of agricultural equipment can help achieve better returns. Modern mechanised farming is in practice in the districts of Haridwar and Udham Singh Nagar, the plain areas of Nainital district, and the Dun Valley, which supply foodgrains to the hill areas. According to the Ministry of Agriculture and Farm Welfare report on monitoring the sub-mission's concurrent evaluation and impact assessment, expenditure on mechanised agriculture in Uttarakhand comes to Rs. 74,111, while the national average is Rs. 66,350. The Uttarakhand Government offers a subsidy of Rs. 23,945 per hectare, while the Central Government offers Rs. 23,314 per hectare.

Progress in the Field of Horticulture and Allied Sectors

Given horticulture's importance to the Himalayan States' economy, the Government of India established a 'Horticulture Mission' in 2003-04. In Uttarakhand, limited agricultural land makes it difficult to sustain the hill population. Therefore, the horticulture economy may act as a supplementary resource for its people. Although credit goes to the British for introducing horticulture in the state during their rule, the area under horticulture increased suddenly after 1950. In 1952-53, the area under horticulture was 1,600 hectares, and apple production was 2,000 tons. Before the formation of Uttarakhand State, the total area under horticulture was

3,43,157 ha, accounting for 6.47% of the state area (1,73,388 ha or 8.36% in the Kumaun region and 1,71,769 ha or 5.27% in the Garhwal region).

In this context, horticulture production includes fruits, vegetables, flowers, and potatoes. In 2005-06, the total area under horticulture was 2,50,639 ha (4.68% of the state's geographical area), which increased to 2,80,896.74 ha (5.25% of the State's geographical area) in 2021-22. As far as production is concerned, during 2005-06, fruit production was 6,92,450 MT, vegetables 4,61,073 MT, and potato 2,76,885 MT, while during 2021-22 it was fruit 6,48,895.88 MT, vegetables 6,56,628.07 MT, and potato 3,67,309.04 MT (Table 2).

Table 2: Production of main horticultural crops in the State (MT)

Year	Fruits	Vegetables	Potato
2005-06	6,92,450	4,61,073	2,76,885
2010-11	7,92,077	6,06,507	4,24,311
2014-15	7,85,965	6,57,157	4,52,495
2021-22	6,48,895.88	6,56,628.07	3,67,309.04

Source: Statistical Diary, Uttarakhand, 2005-06 p. 61, 2010-11 p. 65, 2015-16 p. 61 and 2022-23 p. 69.

Taking into account separately the area and production of fruits and vegetables in the year 2010-11, a comparison between the Garhwal and Kumaun divisions has been shown in Table 3:

Table 3: Area, Production and productivity of fruits and vegetables in both the divisions of Uttarakhand (2010-11)

Division	Fruits - Area Share of State (%)	Fruits - Production Share of State (%)	Fruits - Productivity (MT/ha.)	Vegetables - Area Share of State (%)	Vegetables - Production Share of State (%)	Vegetables - Productivity (MT/ha.)
Garhwal	50.25	50.14	3.74	52.16	52.24	9.54
Kumaun	49.75	49.86	4.33	47.84	47.76	9.37

Source: Directorate of Agriculture, Uttarakhand.

The table shows that, despite less area under fruit cultivation, productivity is comparatively high in the Kumaun division. In contrast, vegetable productivity is high in the Garhwal division. At the district level, Dehradun has the highest area under fruit cultivation (12.92%), followed by Nainital (12.85%) and Almora (12.12%). Of the 13 districts, Rudraprayag has the lowest area under fruit cultivation (1.43%), followed by Udham Singh Nagar (3.37%). In contrast, Almora district has the highest fruit production (22.11%), followed by Haridwar (13.08%), Nainital (12.90%), and Chamoli (12.60%). Rudraprayag district recorded the lowest fruit production (0.70%), followed by Bageshwar (1.95%), Champawat (2.02%), Tehri Garhwal (3.30%), and Pauri Garhwal (3.62%).

Regarding vegetable area and production, Dehradun district also had the highest area and production in the state, accounting for 14.83% and 17.66%, respectively, followed by Nainital district, accounting for 14.14% and 13.64%, respectively. Rudraprayag district had the least area and production of vegetables, accounting for 1.50% and 0.77%, respectively, followed by Bageshwar district, accounting for 2.36% and 1.90%, respectively. After 20 years of the formation of the state (2020-21), the area and production of fruits and vegetables are given in Table 4.

Table 4: Areas and production of fruits and vegetables in the state (2020-21)

Division	Fruits - Area (ha)	Fruits - Share of State (%)	Fruits - Production (MT)	Fruits - Share of State (%)	Vegetables - Area (ha)	Vegetables - Share of State (%)	Vegetables - Production (MT)	Vegetables - Share of State (%)
Garhwal	1,24,410	68.71	2,64,734	40.80	43,428	59.69	3,49,635	53.24
Kumaun	56,600	31.29	3,84,161	59.20	29,330	40.31	3,06,993	46.76
Uttarakhand	1,81,070	100.00	6,48,895	100.00	72,758	100.00	6,56,628	100.00

Source: Computed from the data, Economic Survey (2023-24). Directorate of Economics and Statistics, Planning Department, Uttarakhand, P.69.

A comparative study of the data for 2010-11 and 2020-21 reveals an overall increase in the area and production of fruits and vegetables in the Garhwal division. In the Kumaun division, the area under fruit cultivation has decreased, but production has increased between 2010-11 and 2020-21. However, during the same period, both the area and production of vegetable cultivation declined. At the district level, in the Garhwal division, only Chamoli district showed a decrease in the area under fruit cultivation, while in the Kumaun division, 4 of 6 districts (excluding Almora and Udham Singh Nagar) showed a decrease in the area under fruit cultivation. During 2010-11 and 2020-21, in Chamoli, Dehradun, Haridwar (Garhwal division), Pithoragarh, Almora, and Nainital (Kumaun division), the area under vegetable cultivation declined, and production also dropped.

Data for the last two years (2020-21 and 2022-23) show a sudden decrease in both the area and production of fruit and vegetable cultivation in the state. In these two years, the area under fruit cultivation and fruit production decreased by 54.88% and 56.93%, respectively. Likewise, in this period, the area under vegetable cultivation and vegetable production fell by 79.17% and 76.42%, respectively. During this period, the area under potato cultivation also decreased by 36.41%, and production fell by 49.92%.

Horticultural products also include a variety of spice plants and flowers. The area under spices in 2012-13 was 11,557 ha (Garhwal division 7,087 ha and Kumaun 4,468 ha), increasing to 18,241 ha (Garhwal division 8,293 ha and Kumaun division 9,948 ha) in 2020-21. Likewise, spice production in 2012-13 was 80,328 MT (Garhwal division 45,595 MT and Kumaun division 34,733 MT), which increased to 9,95,993 MT (Garhwal division 53,692 MT and Kumaun division 42,301 MT) in 2020-21. After two years (2022-23), the area under spices in the state increased by 26.1%, but production increased by only 0.9%. Despite less area under spices in the Kumaun division, production is higher than in the Garhwal division. As regards flower production in the state, in 2012-13 the total area under flower cultivation was 1,604 ha (Garhwal division 1,168 ha and Kumaun 436 ha), and total production was 1,996 MT (Garhwal division 1,606 MT and Kumaun division 390 MT). During 2020-21 and 2022-23, the area under flower cultivation decreased by 940 ha. Recently, the State government has also declared the 'Mahak Kranti Policy' to boost this sector.

Currently, the Department of Horticulture has formed clusters for various horticultural crops in every district of the state, considering geographical conditions and agricultural potential. The total number of clusters is 1050, covering 6,563 villages. The details of these clusters are tabulated in Table 5.

Table 5: Details of clusters formed for various horticultural crops

Item	No. of Clusters	No. of Villages included	Covered area (ha)
Fruits	384	2,425	20,187
Vegetables	437	2,307	12,488
Spices	179	1,535	3,801

Item	No. of Clusters	No. of Villages included	Covered area (ha)
Flowers	50	296	1,454
Total	1050	6,563	37,930

Source: *Economic Survey (2023-24)*, Directorate of Economics and Statistics, Planning Department, Uttarakhand, P. 70-71.

Apiculture and mushroom cultivation are also included under horticultural products. In 2023-24, the state produced about 1,600 MT of honey, with 6,162 silent guardians (beekeepers) and 2.71 lakh silent dynasties. Apiculture is a part of the integrated farming system. The government is keen to develop apiculture by making a 'Sweet revolution' to strengthen the slogan of 'Aatmanirbhar Bharat'. Likewise, various types of mushrooms are also being cultivated in almost all the districts of the state. To develop mushroom cultivation, compost units have been established in Jyolikot and Bhowali (Nainital district) and Shakarpur (Dehradun district).

Development of Animal Husbandry, Dairy and Fisheries

In an agriculture-dominated state like Uttarakhand, animal husbandry, dairy, and fisheries, along with agriculture, contribute a major share of the rural economy. Agriculture and animal husbandry are closely inter-related, and each depends on the other. Activities like animal husbandry, dairying and fisheries are more useful to the marginal and small farmers. Thus, they benefit villagers by providing employment and improving their social and economic status. Data from 2003-04 show a steady increase in animal-product production. For example, from 2017-18 to 2022-23, production increased by about 26% over these five years.

Currently, India's dairy industry ranks among the top in the world. Not only men but also a large number of women work in this industry. Up to December 2023, Uttarakhand state had 2,525 dairy milk societies and 1,304 female dairy milk societies. At the district level, Nainital had the most milk societies (603), followed by Udham Singh Nagar (431), Haridwar (246), and Almora (233). Rudrapur had the fewest milk societies (38), followed by Bageshwar (59), Chamoli (75), and Uttarkashi (81). Nainital district had the maximum number of female milk societies (142), followed by Pithoragarh (115), Udham Singh Nagar and Tehri Garhwal (103 each). Rudrapur had the fewest societies (61), followed by Champawat (74) and Pauri Garhwal (90). As regards the production of milk, data received from the year 2019-20 to 2023-24 (up to December 2023), shows that maximum milk production of average 83,638 litre/day, was in Nainital district, followed by Udham Singh Nagar (19,420 litre/day), Dehradun (17,075 litre/day) and Almora-Bageshwar (9,469 litre/day). Milk production is lowest (Average 470 litre/day) in Tehri Garhwal district, followed by Uttarkashi (Average 1,337 litre/day) and Pauri Garhwal (Average 2,333 litre/day).

Recently, 'Badri Cow' milk has been introduced in Joshimath (Chamoli district) and in the Lakhamandal area of Dehradun district. Badri cow milk and butter (Ghee) are rich in antioxidants and Omega-3, making them highly nutritious and hygienic, and therefore costly. In the animal breeding centre of Nariyal Village (Champawat district), 417 Badri cow breed animals are kept. Since the beginning of the formation of Uttarakhand state (2000-01) up to the year 2022-23, the number of veterinary service hospital centres in the state has increased to veterinary hospital-24, animal development centre-191, artificial insemination centre-391, animal breeding farm-01, sheep development centre-04, goat breeding centre-02 and poultry interpolation-04. Currently, the animal department runs many operational plans, programs, and campaigns to maintain animal breeding.

In the state, fisheries is also being developed as an industry. The state's perennial freshwater rivers have been ideal native for fish. The state government has planned to develop fisheries so that more people can earn a good income from this source. To develop fisheries in the state, 38 plans are being operated (district sector-13, state sector-8, and centre sector-17). In the year 2023-24 (up to December, 2023), total employment under various programs for the upliftment of fisheries was 396 (direct) and 1215 (indirect). Due to high demand for trout, the private sector is also producing trout seeds. To boost the state's fisheries economy, an investors' summit was organised in 2023, where a contract worth Rs. 1,900 crore was signed. In Udham Singh Nagar, a state-level 'integrated aquapark' is in progress. To provide security to fish farmers (aquaculturists) in adverse situations, free provision of a policy is being provided.

Industrial Development

At the time of state formation, there were 14,163 industrial units, and this number rose to 83,946 in 2023-24 (up to December, 2023). During this period, industrial units increased 5 times, investment 20 times, and employment 8 times. In the secondary sector, during the period of state formation, Gross Household Product (GHP) was 19.2%, rising to 49.0% in 2019-20. From the beginning of the third All India Industrial Census in March 2001, the state had 15,282 industrial units, employing 40,845 workers. Total investment was Rs. 707.39 Crore. Up to July 2013, total registered industrial units were 40,012, workers 1,99,758, and investment was Rs. 8,50,253 crore. To upgrade the state's industrial sector, the government has introduced several policies from time to time, including the industrial promotion policy, micro-small and medium enterprise policy, special integrated industrial development policy, etc. Since 2018-19, the number of micro and small-scale industries has increased steadily.

Despite topographic heterogeneity and logistical challenges, Uttarakhand also exports its industrial products. On 15th December, the state introduced the 2020-21 export policy. Inland container depots have been established in Pantnagar, Kashipur and Haridwar. A land customs station is also located in Banbasa (Champawat district). Multi-logistic parks have also been developed, one each in Pantnagar and Haridwar. To upgrade the micro and small industries, 106 growth centres have been established. According to 2020 data, the total number of beneficiaries is 27,798.

Development in the Field of Transportation, Education and Health

To develop a region, overall infrastructure is essentially needed. Road extension mainly depends on surface topography, population and its patterns, and the region's economic status and commercial characteristics. Various agencies are involved in road construction; among them, the Public Works Department (PWD) is the main agency. According to 2019-20 data, the total length of roads under PWD was 25,388 km of village roads, 4,511 km of provincial highways, 2,697 km of district roads, 2,113 km of district main roads, 2,091 km of national highways, and 517 km of other highways. Villages having a total population of more than 500 in plain areas and more than 250 in hill areas are being connected by roads through the Uttarakhand Rural Road Development Agency (URRDA). Under the 'Char Dham' project started in 2016, the main roads are being widened and reinforced to provide good services in the state. Under this project, about 900 km of road is being undertaken.

Education is an important factor in a region's development. According to the Right to Free and Compulsory Education Act, 2009, education is now compulsory for children aged 6 to 14. Social development, economic progress, and political maturity mainly depend on the

level of education of the people living in that area or region. According to the 2011 Census, literacy in Uttarakhand was 79.63%, placing it 7th in the country (Male literacy 80.3% and Female literacy 70.70%). During 2001-11, the average literacy in Uttarakhand increased by 7.58%.

Since the formation of the state, educational institutions and the number of students have increased gradually. Therefore, more expenditure is required to maintain educational institutions at all levels. At present, 190 model schools are running in the state. Rajeev Gandhi Navodaya School, Rajeev Gandhi Abhinav Residential School, Atal Utkrisht Vidhyalaya, etc., are providing good education to children. A number of I.I.T. Engineering Colleges and Polytechnic institutions are growing. Sanskrit schools are also being given due weightage; the Directorate of Sanskrit and Sanskrit University at Haridwar are promoting Sanskrit education in the state.

Health is also an important indicator of the State's wellness. In 2005-06, Uttarakhand had a total of 1,631 centres providing different types of medical services (allopathic). This number rose to 1,848 in 2010-11 and 1,897 in 2015-16. At present, the number of different levels of health centres in the state is: Sub-Health Centres 1898, Primary Health Centres ('A' grade) 526, Primary Health Centres ('B' grade) 52, Community Health Centres 80 and other health units 25. As regards the state's health sector budget allocation, over the last 5-7 decades, the health budget has increased regularly, especially after 2021-22, when the slogan 'Sab-Ka-Swasthya' gained wide traction. In the financial year 2021-22, the total allocation in the health budget was Rs. 3,188.95 crore, up 28.74% from the previous year. Likewise, the budget allocation was Rs. 3,53,046.1 lakh in the year 2023-24.

Out of the state's total budget, 4.44% was allocated to the health sector in 2005-06. After five years, this share rose to 4.65% (2010-11); over the next five years, it reached 4.95% (2015-16). This share was 5.96% in 2021-22 and rose to 7.07% in 2022-23. It is to be noted that the Gross Domestic Product (GDP) on this item was 1.01% in 2020-21, and this ratio increased to 1.58% in 2022-23. In the financial year 2023-24, there were 273 Government Ayurvedic Hospitals, which are called 'Ayush Health and Wellness Centres'. In addition, five Unani hospitals have been established in the state. Recently, the first Government Homoeopathic Medical College in the State has been established in the Campus of 'Uttarakhand Ayurved University', Dehradun.

Financing institutions (banks) play an important role in the state's economic development. Regional development requires different types of commercial banks. As of 30 September, 2022, Uttarakhand State has a network of 2,397 bank branches, of which 48.85% operate in rural areas, 24.24% in semi-urban areas, and the remaining 26.91% in urban areas. Currently, 1,171 bank branches are in rural areas, 589 in semi-urban areas, and the remaining 645 in urban areas. According to the 2011 Census, the population per branch in Uttarakhand is 4,208, whereas at the national level it is 11,271. As of 30 September 2022, the total number of public-sector bank branches is 1,346 (S.B.I. 403, PNB 295, Bank of Baroda 134; private-sector branches 402; and the remaining 112 are other branches). By district, Dehradun has the most branches (568), while Rudraprayag has the fewest (53). Table 6 shows the bank-wise branch network.

Table 6: Bank-wise branch network as on 30 Sept. 2022

S. No.	Name of Bank	Rural	Semi Urban	Urban	Total
1.	Total lead bank	492	154	186	832
2.	Total non-lead bank	167	159	188	514
3.	Total Regional rural bank	217	41	29	287

S. No.	Name of Bank	Rural	Semi Urban	Urban	Total
4.	Total cooperative bank	178	89	66	333
5.	Total private bank	113	128	161	402
6.	Total small finance bank	04	10	15	29
	Total of all banks	1171	581	645	2397

The example shows the bank's business in the state. As of 30 September 2022, total deposits were Rs. 1,66,428 crore, and total business growth was Rs. 1,84,133 crore. Public sector banks contributed 71.41%, regional rural banks 3.65%, co-operative banks 6.74%, and private sector banks 17.29%. Bank deposits increased by 10.64% in a year. By 30 September 2022, total bank business crossed Rs. 2,80,949 crore, up 12.19% annually. A number of sponsored programs are also being run by the Government.

In Uttarakhand, almost all revenue villages were electrified by the end of 2019-20. Of the state's total electricity utilisation, more than half (52.4%) is used in the industrial sector. The state's total electricity consumption was 13,217.08 MU (million units) in 2022-23. Under the Electricity Policy 2015, the state is running several projects under the supervision of the Panchayati Raj Uttarakhand Renewable Development Authority (UREDA) and some private sector companies.

Change in Social Status and Behaviour of Human Societies

Besides economic change, social structure has also developed overall. Every citizen of the state is conscious of living in such a place where he seeks protection for his life. Regarding police protection centres (Thanas), there were 121 police protection centres (72 in urban areas and 49 in rural areas) during 2009-10, which increased to 160 (82 in urban areas and 78 in rural areas) in 2022-23. Out of these 160 P.P.O., 126 are in hill areas, and the remaining 34 are in plain areas. Despite this, the state has 257 police chaukies. The degree of social development in the state can be understood by measuring the results of social progress calculated on 12 Feb., 2023 under the Social Progress Index (SPI). It considers nutrition and health protection, availability of water and hygiene, accommodation and individual security, etc. Uttarakhand ranks 14th among the country's states, securing 62.19% marks. Among the Himalayan States, Uttarakhand ranks 5th, while Mizoram ranks 1st. In Uttarakhand, scores from various service sources are: availability of water 50.03%, hygiene 67.94%, accommodation 62.77%, and individual security 67.74%.

Development is an endless process. Therefore, so far the progress in the field of social sectors made in the state has been summarised as under:

Preservation of Cultural Identity

These days, there are worldwide challenges to protect the basic culture of our society. Garhwali, Kumauni, and Jaunsari languages are being promoted and propagated at both the Government level and by non-Government organisations (NGOs). Intangible or heritage culture (folk songs, folk dance, language, knowledge and traditions, etc.) is now being protected. The traditional art of 'Apan of Kumaun' culture is also being promoted and commercialised. Our age-old festivals are being popularised to remind people of their importance, particularly among youths.

Upliftment of Women Class

The increasing trend in the female population (according to the 2011 Census, the annual increase in the literacy rate for males was 0.412%, while for females it was 1.018%) has led more women to enter various sectors of the workforce. As per data for 2021-22, female participation in the workforce reached 38.8%, while the national average is 35%. According to the Directorate General of Employment (DGE), the number of female labourers in India almost doubled between 2017-18 and 2023-24.

In higher education in the state, female participation is about 44%. As per a Times of India survey, the gross enrolment ratio of women was 42.3% in 2019-20, while the male ratio was 40.7%. The Gender Parity Index (GPI) in 2020 was 1.14%, which decreased to 1.09% in 2021. In Uttarakhand, female teachers dominate primary schools. Likewise, in secondary schools, the number of female teachers was 66 per 100 male teachers in 2010, and this ratio recorded 77/100 males in 2011.

At the time of state formation, the police force had 11,000 females. After about 20 years (1 Jan. 2021), the number reached 13,586; again, in Jan. 2022, it reached 16,194, and on 1 Jan. 2023, it reached 21,316. In 2021, the state also established the 'Mahila Commando Force'. By 2023, about 12.2% of all female workers were in the police force. In the year 2013, there were 16 female officers per one lakh females. Improvements in education, physical fitness (physique), and attraction to the police force have been the main factors attracting women to the police service. As per data received from the Directorate General of Police (DGP), Uttarakhand, up to April, 2025, the total approved number of police force in various posts is 28,934; employed against it, 24,565; and the number of females employed is 3,279, which comes to about 13% of the total police force.

For the first time, the National Defence Academy (NDA) recruited females in August 2022. 126 female cadets entered from all over the country. Among them, 3 cadets were from Uttarakhand. In civil service, the state previously gave only 20% horizontal reservation to women, but it is now 30%. In the Village Panchayat, this reservation is now 50%. Women now play a key role in local urban institutions and in government and non-government offices. As of 31 March, 2023, 11,086 female health workers work in recognised social fields as assistant nurses and midwives. About 1,903 women work in Primary Health Centres (PHC) and sub-centres. Before the formation of the state, only a few women worked in politics. Now they actively participate in state politics. In the 2022 assembly, eight of 70 members were women. Of the candidates who contested the 2022 assembly election, eight were from the BJP, five from the National Congress, and seven from APP.

For a long time, women have been the backbone of Uttarakhand's rural economy. Their participation in agriculture and in animal husbandry and allied sectors is more than 90%. Their self-help group in rural areas are powerful organisations. From the beginning, women have been active in various village activities, viz. Chipko Andolan for forest protection, social and environmental agitation, prohibition of alcohol, eco-tourism, organic farming, handicraft, etc. These days, with education, the tendency for entrepreneurship among females is increasing. As a result, women can run their own businesses without support from family members. In the state, female participation in the local court (Judiciary) is 33%. At present, 40% of judges are female, 32% of the panel of advocates are female, and 53% of individual law volunteers are female.

Regarding regional social development and change, we must ensure that these activities do not create other problems in the state. The state faces an acute employment problem for highly educated male and female youths, particularly in technical trades. Such youths,

particularly females, do not want to remain in the hill areas. They are naturally drawn to the plains or to outside the state, where job opportunities are better. Therefore, development must be balanced; only then will it be known as 'Model Development'. The state is climbing the steps of development, but so far the ongoing development is beyond what the people of this region expected. In fact, quantitative development requires qualitative development.



*Article***Tourism, Environmental Stress and Human Well-being in Uttarakhand: Rethinking Development Pathways in the Himalayan State***Vidushi Dobhal Naithani¹* Arvind Singh Rawat² M M Semwal¹**¹Department of Political Science, Hemvati Nandan Bahuguna Garhwal University, Srinagar Garhwal. Uttarakhand, India.**²Dr. Ambedkar Centre of Excellence (DACE), Hemvati Nandan Bahuguna Garhwal University, Srinagar Garhwal. Uttarakhand, India.**¹Department of Political Science, Hemvati Nandan Bahuguna Garhwal University, Srinagar Garhwal. Uttarakhand, India.***Email: vidushi.dobhal@yahoo.com***Abstract**

Uttarakhand's economy has been driven significantly by the tourism sector. It is estimated to contribute approximately 15% to the state's GSDP. This paper examines whether tourism development and rising tourist footfall remain aligned with the host population's well-being. Quantitative data on recorded tourist visits and revenue are supplemented by a qualitative analysis of available digital documentation reflecting public sentiment and resentment toward growing overtourism in the state. The paper also discusses in detail the challenges of overtourism for the fragile Himalayan state of Uttarakhand. The paper uses recorded visits to major tourist destinations in Uttarakhand over the years and the projected resident population to estimate the Tourism Intensity Ratio (TIR) of approximately 5.19 in 2025. The findings suggest a shift in policy approach to evaluate the tourism sector's success and align it with the long-term goals of sustainable development and human well-being.

Keywords: Overtourism; Carrying capacity; Uttarakhand Tourism; Tourism Intensity Ratio.

Introduction

For Himalayan states like Uttarakhand, which offer a wide range of tourism opportunities, the challenges associated with growing tourism are multifaceted. The sector is recognised as having evolved considerably into a significant source of employment and long-term economic development, rather than merely being associated with holidaying (Directorate of Economics and Statistics, Government of Uttarakhand, 2026).

The United Nations and World Tourism Organisation (WTO) define tourism as an activity in which people travel to and stay in places outside their usual environment. This can be done for leisure, business or other purposes (United Nations & WTO, 1994). It also defines sustainable tourism, which considers the current and future impacts of activities on visitors and host communities.

The conceptual shift towards sustainable tourism was encouraged as the world began engaging more with sustainable, long-term development. Organisations such as the United Nations Environment Programme (UNEP) and the World Tourism Organisation (WTO) have emphasised the government's role in ensuring the proper implementation of sustainable tourism policies. Additionally, it holds stakeholders and tourists responsible for ensuring policies are effective (UNEP & WTO, 2005). Tourism can no longer be looked at as an isolated industry. It is embedded throughout the 2030 Agenda for Sustainable Development, including crucial areas such as job creation, support for local culture and employment, sustainable settlements, and climate action (United Nations, 2015). The SDG 2030 framework also

establishes that tourism's value is not merely economic but is assessed through sustainability and other qualitative outcomes.

In line with these developments, discussion of sustainable tourism has grown as global scholarship moves toward a stance that examines development 'beyond GDP'. This approach aims to distinguish tourism *scale* from its overall long-term impact on the host community's well-being (Dwyer, 2023). The approach argues that the tourism industry's success was traditionally defined by quantitative metrics such as tourist footfall, revenue, hotel occupancy, and GSDP contributions. Beyond GDP, the well-being approach broadens the discussion to include quality of life, resource competition, and the ecological challenges associated with a growing, unregulated tourism industry. Reports such as the OECD Tourism Trends and Policies 2024 also note that tourism pressure adversely affects communities and the environment (Organisation for Economic Co-operation and Development, 2024).

Growing scholarship justifies this shift in approach. Studies on residents' perceptions and quality of life have repeatedly emphasised long-term impacts on host communities rather than visitors' momentary experiences (Kim et al., 2013; Uysal et al., 2016). These considerations matter in the Himalayan region. The fragility and inaccessibility of the mountain regions make development conditional on numerous natural factors. At the same time, growing tourism and resource exploitation further intensify the challenges. Thus, developmental and tourism policies must first focus on safeguarding the natural system on which the industry itself depends (Wester et al., 2019). This is especially important in Uttarakhand, where geographical diversity drives a wide range of tourism opportunities. In its report on Sustainable Tourism in the Indian Himalayan Region, NITI Aayog calls for tourism policies centred on sustainability, inclusiveness, and the long-term goals of mountain development (NITI Aayog, 2018).

Against this backdrop, the current paper aims to understand the development and growth trajectory of Uttarakhand's tourism industry. It also discusses the growing need to assess scientific carrying capacity and develop inclusive government policies. By approaching tourism development through traditional and well-being lenses, the paper aims to highlight pressing issues, including public resentment, civic mismanagement, and residents' well-being, in the context of Uttarakhand's tourism policy. It also aims to initiate a conversation about a restructured, holistic tourism policy approach that can help achieve long-term goals for the well-being of the Himalayan state.

Study Area

The study focuses on the Himalayan state of Uttarakhand. The state is in northern India in the central Himalayan region. Uttarakhand lies between 28° 44' & 31° 28' N Latitude and 77° 35' & 81° 01' East longitude. With a geographical area of 53,483 sq. km. (Uttarakhand Biodiversity Board, n.d.), Uttarakhand constitutes approximately 1.6% of the country's total area. The state contains both hilly and plain terrain that spans across 13 districts. The state can be divided into three physiographic zones: the Himalaya, the Shivalik, and the Terai Region. Given its unique geographic location, the state offers a vibrant opportunity for growth in the tourism industry. Uttarakhand's principal tourism assets include the Char Dham Yatra, trekking and adventure activities, river rafting, and scenic hill stations like Nainital and Mussoorie. The region's fragility also raises concerns about responsible and sustainable tourism.

Methodology

The study uses secondary data, including official government reports and statistics, policy documents, newspaper reports, and publicly available content from social media and other relevant electronic platforms. Information gathered from social media is not treated as a quantifiable, statistically representative source. It is, however, perceived as documentation of citizens' day-to-day lived experiences, particularly locals in the state directly affected by the pressures of overtourism in Uttarakhand.

In today's age of widespread digital reach and rapid information sharing, one can no longer dismiss the importance of such content. The large volume of content available online for public consumption, including posts, videos, comments, and discussions, often captures the reality and the perception of citizens. This version of information remains missing from official documents and government narratives. In Uttarakhand, digital media has emerged as an important platform for independent journalists and social and civic commentators to address the state's social, economic, and development issues.

We accessed publicly available videos on social media platforms such as X, Instagram, and YouTube using thematic keywords including carrying capacity, public resentment, traffic congestion, waste management, and *overtourism in Uttarakhand*. This paper discusses only incidents also covered in news reports. Many incidents found duplicate coverage across platforms or lacked media coverage. However, several posts could be traced to the original account and had generated substantial online discussion. The absence of journalistic reporting should not be interpreted as evidence that these incidents did not reflect resident sentiment; rather, it reflects the study's decision to adhere to stricter criteria. While not cited, such posts helped develop the authors' contextual background and sensitised them towards recurring themes. Keeping research ethics at the centre, the social media content analysed was sourced from reliable sources within the strictly defined time frame of 2024 to 2026 to ensure analytical consistency.

Results

Tourism as the Growth Driver for Uttarakhand

Since its inception as a separate state, Uttarakhand has aimed to brand itself as a vibrant tourist destination. Uttarakhand is among the few states with a diverse and unique mix of geographical and spiritual significance, making it not only a sought-after tourist destination but also a pilgrimage destination. With its Himalayan landscape, the religious presence of the Char Dhams, adventure tourism potential, and wellness potential through cities like Haridwar and the yoga capital, Rishikesh, the state has a clear vision for long-term development and a significant boom in the tourism sector.

The state developed its first tourism policy in 2001, with a committed focus on sustainable tourism and on using tourism to create more jobs and opportunities for the local economy. The state formulated a second dedicated tourism policy only 17 years after the first. The Uttarakhand Tourism Policy 2018 aimed to consolidate more than a decade of experience and the challenges faced by Uttarakhand's evolving tourism sector. The policy identified tourism as an 'industry' to put Uttarakhand on the global map as a sustainable, world-class tourist destination. However, the policy was guided by the principle of aggressive marketing for Uttarakhand tourism. The state used marketing strategies to attract investment, improve

infrastructure, and support local entrepreneurship (Department of Tourism, Government of Uttarakhand, 2018).

Uttarakhand currently functions under the Tourism Policy 2023, which is in force for 7 years, till 2030. The policy highlights Uttarakhand as an environmentally sensitive and land-scarce state. It thus aims to revamp tourism to be not only unique and unmatched but also inclusive, benefiting local communities, safe, and disaster-resilient. It states that high-value, low-volume tourism would create an ecologically manageable impact on the state's resources while offering tourists a quality experience (Department of Tourism, Government of Uttarakhand, 2023).

Currently, the tourism sector contributes an estimated 9% directly to the state's GSDP; this contribution is estimated to increase to 15% if allied sources are also considered (Directorate of Economics and Statistics, Government of Uttarakhand, 2026). Given the annual growth in tourist inflows, the sector's economic significance cannot be ignored. Uttarakhand also aims to attract private investment by offering incentives for tourism projects through platforms such as the Global Investor Summit 2023, where the Prime Minister highlighted the state's tourism potential and encouraged investment in yoga, Ayurveda, pilgrimage, and destination weddings (Prime Minister's Office, 2023).

Demographic Imbalance and Tourism Pressure

Over the past two decades, since the state's inception, tourist inflow has increased fivefold. According to government reports, 11.14 million tourists visited Uttarakhand's major tourist destinations in 2000 (Fig. 1). This number declined significantly in 2020, down from as many as 39.23 million tourists. As COVID restrictions eased and connectivity improved, the most recent data from 2024 show a significant footfall of approximately 59.55 million. According to government records, the number of tourists reached a record high in 2025, with the state welcoming nearly 60 million visitors (Singh, 2026).

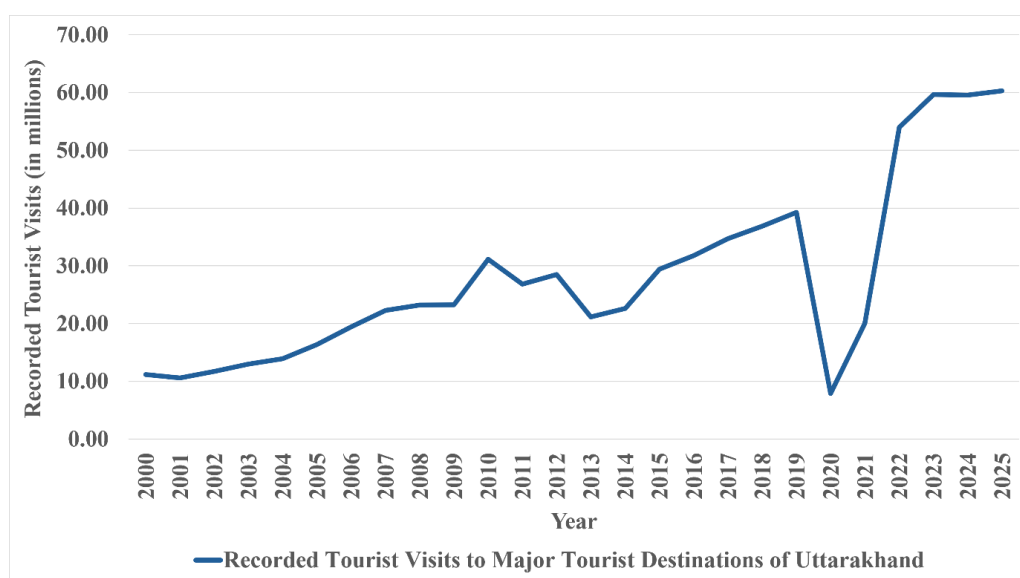


Fig. 1. Recorded Tourist Visits to Major Tourist Destinations of Uttarakhand (2000-2025)
Source: Authors' compilation based on Uttarakhand Tourism Development Board (n.d.-a, n.d.-b, 2023, 2024) and Singh (2026) for the 2025 provisional figure.

Demographic statistics matter at this point. Based on the 2011 Census, Uttarakhand's population is approximately 10.086 million. Based on projections of the National Commission on Population (2020), the resident population in 2025 would be approximately 11.61 million. This suggests that, in 2025, the state is handling recorded tourist visits that are approximately five times its population. Population projections from the National Commission on Population (2020) indicate that Uttarakhand's population is expected to reach nearly 13 million by 2036, with an annual growth rate of 1.01%. Given that Uttarakhand's official geographical area is 53,483 sq. km, the population increase would also raise density from 189 to 243 persons per sq. km by 2036.

Using the annual growth rate, the estimated population for each year can be calculated. The demographic pressure can then be determined using a Tourism Intensity Ratio (TIR), which divides annual tourist footfall by the estimated resident population for a specific year. Table 1 includes the calculated annual tourist footfall against the estimated resident population projections. Using these numbers, we calculated the TIR.

The estimated population for any year can be calculated using:

$$P_t = P_{2011} (1 + r)^{t-2011}$$

Where:

- P_{2011} is the base population = 10.086 million
- t is the year of the estimated population
- r is the rate of annual growth ≈ 0.0101 or 1.01% per year

Tourism Intensity Ratio (TIR): the ratio of tourists visiting the state to the state's resident population.

$$TIR = \frac{\text{Annual Tourist Footfall}}{\text{Estimated Population}}$$

By using the estimated population for 2025 and the latest recorded annual tourist footfall of 60.30 million, the TIR for the year 2025 can be determined as follows:

$$TIR (2025) = \frac{60.30}{10.086 (1.0101)^{14}}$$

$$TIR (2025) \approx 5.2$$

Thus, given the most recent projections and estimates, the state is handling tourist pressure nearly five times its resident population. The ratio does not measure the simultaneous presence of tourists per resident at a given time, as tourists may visit multiple sites and their presence may be recorded at multiple instances. Hence, rather than directly measuring capacity, the ratio discussed here shows aggregate tourism intensity relative to the resident population (Table 1).

Table 1: Calculation of Tourism Intensity Ratio (TIR)

Year	Recorded Tourist Visits (T) (in millions)	Estimated Resident Population (P) (in millions)	TIR = T / P
2016	31.78	10.60	3.00
2017	34.72	10.71	3.24
2018	36.85	10.82	3.41
2019	39.23	10.93	3.59
2020	7.87	11.04	0.71
2021	20.02	11.15	1.80
2022	53.98	11.27	4.79

2023	59.63	11.38	5.24
2024	59.55	11.50	5.18
2025	60.30	11.61	5.19

Over the last ten years, the Tourism Intensity Ratio (TIR), despite pandemic-related interruptions in 2020 and 2021, has increased from 3.0 to 5.2, a roughly 73% increase. This is significant compared with the modest population growth of nearly 1% per annum. This pressure intensifies because tourist inflow is concentrated during peak tourist season, the months coinciding with the Char Dham Yatra and summer vacation across the nation. This trend is even more concerning because, as many government sources confirm, the current population is concentrated only in the state's plains. The population in Uttarakhand's hill districts has declined over the years due to migration (Mamgain & Reddy, 2016). This is also where development occurs and where policies are focused geographically. This demographic divide matters when analysing the state's tourist inflow. Uttarakhand faces not only overtourism but also collateral damage, as shown by pressure on transport corridors and civic amenities, which bear the brunt of the surge in visitors during peak tourist season.

Thus, the point of contention among civil society and citizens in the state is gradually shifting. The questions are no longer whether Uttarakhand can attract tourists, but whether the state's already-pressurised civic, administrative, and ecological systems can absorb seasonal surges that leave long-term impacts.

Beyond the Carrying Capacity

The term carrying capacity has been widely discussed across academic literature and policy documents in the context of Uttarakhand tourism. However, the on-the-ground implementation reflects a different reality. In 2022, a National Green Tribunal (NGT) Panel recommended a check on the tourist inflow in Mussoorie. Citing the hill station as Uttarakhand's most popular, the panel highlighted concerns about growing pressure on civic amenities, infrastructure, and parking in the hill city (Press Trust of India, 2023).

A GIS-based mapping study calculated the sustainable daily visitor threshold of the Char Dhams as 15,778 (Badrinath), 13,111 (Kedarnath), 8178 (Gangotri) and 6160 (Yamunotri) (Kuniyal et al., 2025). The state government also announced similar daily visitor caps earlier in 2023, rolled them back a day before the Yatra began, and did so again in 2024. However, it did not implement the restriction. In 2023, the National Green Tribunal directed the state government to develop a scientific action plan to limit visitors and vehicles at the shrine. Until then, the NGT directed that the previous carrying capacities be treated as limits pending the finalisation of a study. The Wildlife Institute of India drafted an interim report on the carrying capacity, which is currently under consideration in the ongoing NGT proceedings (National Green Tribunal, 2026).

Public Resentment

This paper uses digital evidence and documented coverage of online content shared by residents across Uttarakhand to depict their plight due to the growth of overtourism. This resentment can be understood through broad themes of unruly tourist behaviour, public safety and local well-being, disregard for pilgrimage sites, environmental consciousness, lagging

civic sense, and administrative lapses. Evidently, the ‘tourist vs. resident’ tension has been on the rise across major tourist destinations of Uttarakhand (Sharma, 2026).

Widely shared videos on social media and other journalistic content have been treated as documented evidence of resident sentiment. The mere variety of such content available online suggests that the ‘tourist vs. resident’ conflict is not a standalone incident but rather a crucial part of a pattern that is becoming increasingly routine and being expressed as everyday civic frustration among the locals. A detailed news report by *The Print* (Sharma, 2026) documents statements from residents who agree that incidents of public nuisance and civic disturbances have become more frequent in recent years. Government officials also point out the stark difference in attitudes towards the tourist site between the tourists' and the residents' perspectives. Tourists come for recreation, whereas residents view their presence and behaviour as disrespectful to their culture and ecological traditions. Therefore, conflicts related to public drinking, littering, loud music, and unruly behaviour have become more common, especially due to overlapping tourist themes at certain sites where religious/spiritual tourism intersects with other themes, and the consistent underlying ecological fragility and how the local community regards it.

Earlier, the public resentment was reflected through verbal spats, civic correction, and critical comments across social media and other digital platforms. Although these still continue, a growing concern since the previous year is reports of conflicts that have turned into physical confrontations and assaults.

For example, a video from Nainital (July 2025) went viral, showing a resident confronting a tourist who appeared indifferent to their littering (DH Web Desk, 2025). A similar incident was reported from Nainital in December 2024, where a woman confronted tourists for littering in the Lover's Point area despite having a dustbin just a few feet away. The video titled ‘*this is how most tourists treat mountains...*’ gathered massive online support for the woman who corrected the tourists' behaviour (TOI Trending Desk, 2024). A more recent incident was reported by *The Indian Express*, where environmental advocate Anoop Nautiyal was seen confronting tourists who threw plastic waste out of a moving taxi on their way to Mussoorie. The video and Nautiyal's sense of civic responsibility were widely appreciated, as the act sparked conversation about tourists' environmental responsibility (Trends Desk, 2026). More recent incidents of tensions turning violent have been reported at tourist sites such as Mussoorie and Rishikesh, where confrontations have arisen over issues such as parking spaces, loud music, and traffic disputes (Rawat, 2026; Mishra, 2026). The recurrence of such incidents over near-identical triggers suggests underlying tourist stress across Uttarakhand's sites rather than isolated, unrelated disputes.

Digital documentation from Uttarakhand pilgrimage sites also suggests growing concerns. Videos circulated from the Char Dhams show overcrowded hill paths, poor crowd management, and pressure on waste management systems, along with indifferent and unruly visitors, suggesting pilgrimage sites are becoming viral locations for digital consumption and recreational tourism. Locals' responses indicated unease about the growing influencer culture and ‘reels-based’ tourism, which they believe diminishes the importance and sanctity of pilgrimage sites and turns these destinations into mere picnic spots (ET Online, 2026; Tiwari, 2024). Such criticism was already visible during the 2024 Char Dham Yatra season. Numerous news reports documented growing concerns among priests and locals about reel-based tourism and its impacts. Several videos circulated online showing loud musical performances, constant filming, and even loud musical instruments being played near the shrine. Locals believed this not only compromised the sanctity of the religious site but also significantly disturbed the ecologically sensitive high-altitude Himalayan landscape (Singh, 2024).

Public resentment with pilgrimage pressure is not confined to the Char Dham circuit. News reports from Haridwar over the years have indicated growing concern among residents about the annual Kanwar Yatra. These include traffic congestion, unsafe driving, public fear, noise pollution, and a waste management crisis (Jaiswal & Talwar, 2019). More recent reports from 2024 and 2025 raised concerns about excessive waste generation, traffic congestion, and noise pollution. Haridwar generated 6,000 tonnes of Kanwar-related waste in 2024 (Nawaz, 2024; Nawaz & Jaiswal, 2025). The examples of Haridwar and Kedarnath show the civic costs local residents bear in accommodating mass visitors.

Excessive visitor pressure in the Himalayan region is not just a number; it creates real risks in the mountains with limited carrying capacity. In June 2026, the Garhwal Post reported that an ambulance carrying a critically ill patient was stuck in a traffic jam due to roadside parking on Mussoorie's narrow roads, which hindered its movement. The ITBP ultimately diverted it. This instance demonstrates how vehicular pressure directly affects public safety and access to essential services during emergencies (Garhwal Post Bureau, 2026). The strain of overcrowding is not confined to pilgrimage routes; urban tourist spots like Robber's Cave in Dehradun have also reported large crowds crammed into narrow cave passages during the peak tourist season. This also suggests a clear strain on local infrastructure and raises public safety concerns (Times Travel, 2024).

The digital dimension associated with this evidence is particularly important to the current analysis. Firstly, records of incidents such as littering and confrontation would not even have entered the academic domain or been part of the journalistic inquiry if the videos had not been widely circulated on social media. Moreover, digital platforms are becoming sites where incidents are not merely posted but circulated, discussed, and even analysed.

Such digital platforms also serve as means of organising resentment through campaigns and appeals. The most recent example emerged in May 2026 when a video was circulated in which two tourists from Haryana were assaulted by the locals after a verbal confrontation. After this incident, several social media and travel influencers took to their platforms to join the #BoycottUttarakhand campaign, calling for a year-long boycott of tourist destinations such as Haridwar and Rishikesh. The tourist industry's importance to Uttarakhand's economy became a trigger. The Boycott Uttarakhand movement reflected reciprocal hostility from visitors and organised itself just days after the incident video went viral, entirely through a hashtag-driven campaign.

As mentioned earlier, social media content, though not statistically representative, serves as an evidentiary source that captures residents' lived experience in the state. This reflection remains absent from government documents, official reports and policy documents. Thus, as supplementary qualitative evidence, it reinstates the underlying argument that the tourism industry, although economically beneficial, requires a reoriented approach. The success of the tourism industry cannot be gauged by footfall, revenue, and investment numbers alone. Rather, the quality of life of the host community, the dignity and ecological sanctity of the destination, and the everyday lives of residents must be assessed against the growing inflow of tourists.

Discussion

The growing resentment of locals against tourists finds theoretical grounding in Doxey's (1975, as cited in Pavlić & Portolan, 2015) Irritation Index, or "Irridex," which posits that residents' attitudes evolve as tourist volume increases relative to the host population. The index proposes that the destination goes through four stages of attitudinal response: euphoria, in which tourism is welcomed because the benefits outweigh the costs; apathy, in which residents

become accustomed to tourists' presence. As recorded tourist visits increase, the destination goes through the next stages: irritation, then antagonism. This contextualises tourism growth with adverse socio-cultural impacts, to the extent that the host community, which welcomed tourists in the first stage of euphoria, eventually holds tourists responsible for social, economic, and ecological impacts on their community in the last stage of antagonism.

Read against this framework, some characteristics of the present response of the citizens of Uttarakhand appear consistent with the third stage of irritation, described as the phase in which residents become concerned about the growing number of tourist arrivals and the competition for resources that arises from it. This competition is evident in Uttarakhand through its already overburdened road network, limited parking capacity, civic security challenges, inadequate waste management infrastructure and the eroding ecological harmony for which the hills were once famous.

Although there is no defined 'optimal' tourist-to-resident ratio in available literature about tourism, the carrying capacity of any area may be dependent on a variety of factors. Even the United Nations World Tourism Organization does not quantitatively define the parameters of carrying capacity but rather examines it through the lens of lived experience, resident-visitor satisfaction, infrastructural preparedness, and ecological impact. It defines tourism carrying capacity as the maximum number of tourists that may visit a tourist destination without disrupting the socio-economic, physical, economic and environmental quality and causing an unacceptable decrease in visitor satisfaction (World Tourism Organisation, 1981, as cited in Yusoh et al., 2021, p. 4).

Independent research, institutional reports and digital documentation point towards pressure on the carrying capacity of tourist destinations in Uttarakhand. The government must therefore adhere to a scientifically determined daily visitor limit, especially at ecologically fragile and sensitive pilgrimage sites. In ecologically sensitive mountain areas, such as Uttarakhand, exceeding carrying capacity not only strains limited resources but also compromises administrative capacity to respond to unforeseen events, such as natural disasters. Uttarakhand has a complex geographical terrain. This intensifies during peak tourist season, when demand for effective civic management is highest. Addressing this intensification requires leadership from senior, experienced bureaucrats capable of coordinating a quick response under resource pressure. As the resident-visitor relationship evolves across Uttarakhand, administrative officials must be especially trained to manage these dynamics. A policy's effectiveness is realised only through its implementation. If the governance lacks the administrative capacity to implement a well-conceived policy, its impact remains contingent.

Given the vast pool of academic, journalistic, and institutional reports, it is evident that the administration lacks no means to reach an informed judgment on tourism policies. Tourism policies must align the immediate goal of revenue generation and regional prosperity with the long-term goal of human well-being and sustained growth. This requires administrative efforts that are not only responsive but also vigilant and accountable.

Holding a destination-specific, multi-stakeholder dialogue, keeping in mind the economic, socio-cultural and geographical demands of the tourist destination, is essential. Policies like Winter Char Dham tourism and branding offbeat locations must not be treated as a substitute for enforceable regulations, waste management, and other environmental monitoring and auditing measures that the government and administration must actively implement.

Local communities, business owners, hotel associations, tour operators, and guides must be organised and trained on a destination-specific basis. This matters because many destinations in Uttarakhand fall under multiple, overlapping tourism themes. A single site, like Rishikesh, might operate as a pilgrimage centre, an adventure experience for rafting

enthusiasts, a wedding destination, a camping site, or a wellness yoga retreat. Thus, a clear and strict Standard Operating Procedure (SOP) is necessary for effective management. These can be circulated through hotel helpdesks, tour guides, skilled tour operators, and ‘Paryatan Mitras’ (Department of Planning, Government of Uttarakhand, 2018). This would not only improve visitor management but also generate skilled employment, strengthen civic sense and promote responsible tourism practices.

Lastly, policy reforms would not succeed without dedicated political will. The state must resist its tendency to dilute and ease regulations for short-term economic benefits. Instead, the state must negotiate and engage stakeholders, keeping the well-being of Uttarakhand's people at the centre. Heritage conservation, respect for local sentiments, environmental clearances, and public reporting must move at the same pace as tourism branding.

Conclusion

The core of this argument lies in the need to restructure the way growth and development are visualised for the Himalayan state. The growing importance of tourism in Uttarakhand positions the industry not only as a beneficiary of infrastructural investment but also as an active means of attracting national-level attention regarding sustained development. By extension, the local and transient tourist populations become the twin nodal points in the state's developmental narrative. This raises the question that has been central to the query of this paper: whether policies designed to accommodate transient, peak season demands of tourists can have long-term, durable benefits for the host population, or does it risk drawing ecological and social adversities that embed deeper in the system and surface even beyond the tourist season.

Policies in Uttarakhand require a ‘beyond GDP’ and ‘beyond footfall’ approach. Measuring the success of the tourism industry solely by footfall numbers, hotel occupancy, and revenue fails to capture the everyday lived experience of both the visitor and the host. The costs of unregulated tourism are evident in traffic congestion, public resentment, ecological challenges, and administrative incapacity. Thus, economic success must be viewed through the lens of long-term consequences and their impact on sustainability. Given the state's current model, the trade-offs are steep, with irreparable costs to the fragile mountain landscape. An urgent reorientation in approach is required.

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*Article***Spatial Pattern of Socio-Economic Development: An Analysis of Chakrata and Shillai Blocks in the Western Himalayas***Kumari Sapna*, D.D. Sharma**Department of Geography, Himachal Pradesh University, Shimla***Email: sapna.surya05d@gmail.com***Abstract**

Socio-economic development in mountain areas is uneven because of difficult terrain, poor road accessibility and very limited livelihood opportunities. Although research on mountain development exists, few village-level studies combine statistical data with people's perceptions, especially in the Western Himalayas. This study analyses the socio-economic development of Chakrata Block in Uttarakhand and Shillai Block in Himachal Pradesh based on Census of India data from 2001 and 2011, along with a household survey conducted in 2024 covering 386 households in 20 villages. The study used the Z-score method to combine eighteen socio-economic and infrastructural indicators to generate a Composite Standard Score (CSS). A perception index based on 14 indicators assessed residents' perceptions. Chakrata block has shown better development due to higher literacy, good accessibility, and well-implemented government programs. But Shillai block suffers from its remoteness, very little developed infrastructure, limited non-farm jobs and out-migration of young people. It also shows that a strong position in development indicators does not mean people there are satisfied. The study emphasised that implementing area-specific policies is crucial to improving connectivity, livelihood opportunities, and access to basic services in the Western Himalayas.

Keywords: Socio-economic development, regional disparity, Western Himalayas, migration, perception.

Introduction

Development is not only about earning more money, having a higher income, or building better roads and other facilities. It also means improving people's quality of life. It also includes quality education, good healthcare facilities, higher living standards and overall well-being. Human resource development is an important part of this process since people's knowledge, skills, and abilities shape their capacity to access opportunities and improve their quality of life (Sultana & Aktar, 2016). Development combines economic progress with improved human well-being. This overall concept is termed socio-economic development. It encompasses not only material progress but also people's quality of life. This is also relevant in the context of economic growth in developing countries where economic inequality is frequently accompanied by social and regional inequality (World Bank, 2023). Gross Domestic Product (GDP) and per capita income can also indicate development, but they do not provide a full picture. Education, healthcare, employment, social equality, and living conditions are also related to development (Nuralina et al., 2023). Many other factors also relate to quality of life. These include health, education, employment, the environment, and social relationships (Beltramo et al., 2024). This is also reflected in the Sustainable Development Goals (SDGs). They focus on inclusive development, improved living conditions, and addressing inequalities (UNDP, 2023).

Regional disparities are still a major challenge in India. Some areas have seen improved industrial development, technology, infrastructure, and governance. Other parts of the country are less developed. They tend to be heavily reliant on agriculture. They also lack infrastructure and employment opportunities. Consequently, people migrate to find jobs and better living

conditions elsewhere (Drèze & Sen, 2020; Chandrasekhar & Ghosh, 2021). So, regional inequality and migration are closely related. Migration often responds to uneven development, but it can also worsen existing regional imbalances by reducing the local workforce and slowing economic growth (Tiwari et al., 2022). These differences are particularly noticeable in mountain regions, where development is affected not only by economic conditions but also by difficult terrain, climate, and scattered settlement patterns. The Indian Himalayan Region (IHR) epitomises these challenges. Rugged mountains, remote locations and scattered villages limit economic opportunities and make access to basic services difficult. Over the years, large-scale out-migration from many Himalayan villages has led to declining populations, the feminisation of agriculture, and farmland abandonment, all of which have weakened local development (Kumar et al., 2025). Many rural communities still have poverty, poor infrastructure, weak transport links and limited access to health care and education (Rasul & Nepal, 2025). Therefore, migration is both a sign of underdevelopment and a process that can increase socio-economic inequalities (Tiwari et al., 2022).

The Western Himalayas, especially Uttarakhand and Himachal Pradesh, face many development challenges. Roads are often poor or limited, public services may be far away, children have fewer educational opportunities, families struggle to reach healthcare facilities, and farmers and small businesses may struggle to reach larger markets. These problems affect people's livelihoods and quality of life (Jodha, 2005; Karpouzoglou et al., 2020). In Uttarakhand, local job opportunities are often limited. Educational facilities are also weak in many remote areas. These conditions encourage young people to move to towns and cities. As a result, some villages have very few residents. Some villages have even become completely abandoned. This has increased regional differences (Kumar et al., 2025). Himachal Pradesh has generally shown better socio-economic development. This is linked with better infrastructure, stronger governance, and greater community participation (Devi & Tiwari, 2023; Raj et al., 2019). Inequalities still exist; even nearby villages can differ in road access, public services, terrain, and job opportunities (Kreutzmann, 2001). Development indicators do not always show people's real experiences. A village may have a road, school, or health centre. But people may still be unhappy if these facilities are difficult to access. Poor maintenance and low service quality can also reduce satisfaction. Therefore, people's views are important in development studies. This is especially true for rural and mountain areas (Wangdi, 2026; Beltramo et al., 2024).

Earlier studies also found a gap between physical development and people's satisfaction. This gap is more common in remote areas (Bhattacharyya et al., 2021; Bernard, 2018). If they don't see meaningful change in their lives, people may move. Migration can further undermine local development. It can foster an out-migration-decline cycle (Beltramo et al., 2024). Research in India too indicates that migration can raise household earnings. However, it is not necessarily associated with the overall quality of life of poor families (Tiwari et al., 2022). For this reason, researchers should examine both quantitative and qualitative measures of development. The study was conducted in two blocks: Chakrata block of Dehradun district, Uttarakhand, and Shillai block of Sirmaur district, Himachal Pradesh. Both the blocks are in the western Himalayas. Some of their common problems are rough terrain, shifting weather, and not enough farmland, and they have some distinct differences too. Chakrata has more scattered settlements than other places. It is also less well connected to the road networks. Settlements in Shillai are smaller. It also has a little better road access (Census of India, 2011). These similarities and differences allow the two blocks to be compared. These are quantifiable indicators, such as infrastructure, population and economic conditions, which have been the focus of earlier research. These kinds of studies are beneficial. However, less attention has been

paid to people's views on development. Few village-level studies still integrate development indicators with people's perceptions. This study aims to fill these gaps. It integrates socio-economic development indices from the Census with household survey data. This provides a wider perspective of development and regional disparities in the Western Himalayas.

The study has two main objectives. This paper first investigates the pattern of socio-economic development at the village level in Chakrata and Shillai. Second, it explores people's perceptions of development in the selected villages. The study uses secondary data and people's perceptions to better understand development in remote Himalayan communities.

Study Area

The study area comprises the Shillai Block of Sirmaur District, Himachal Pradesh and Chakrata Block of Dehradun District, Uttarakhand. Both the blocks are situated in the western Himalayas. They lie between 77°33'E-78°03'E longitude and 30°37'N-31°00'N latitude (Fig. 1). The region lies within the Middle Himalayan Mountain belt. It is rugged, with steep slopes and deep valleys. The physical environment creates challenges for settlement growth. They also make road and infrastructure construction challenging (Jodha, 2005). Poor road connectivity is a major problem in many areas. Subsistence farming is also the primary means of livelihood for people. Very few employment opportunities are available in the area. Seasonal migration is also seen. These factors have led to unequal socioeconomic development in the region (Karpouzoglou et al., 2020; Tiwari et al., 2022).

Shillai Block is located in Trans-Giri. The terrain is challenging, and road access is limited. Local life and opportunities are also shaped by the socio-cultural identity of the Hatti community, as well (Negi, 1998; Bharadwaj et al., 2024). The Chakrata Block is a part of the Jaunsar-Bawar region. It also faces problems due to geographical isolation. Winter often brings heavy snowfall, which can negatively affect road transport. It can also limit economic activity for extended periods (Berreman, 1963; Kreutzmann, 2013). The Tons River creates a natural divide between the two blocks and affects the drainage patterns, land use, and regional flow in and out of the area (Singh & Singh, 2011).

Overall, Shillai and Chakrata are remote Himalayan areas where harsh terrain, climate, social characteristics, and inadequate infrastructure shape living conditions and local progress. Although the two blocks share a broadly similar physical setting, they differ in several socio-economic aspects. These similarities and differences make them suitable for examining spatial inequalities at both the block and village levels.

Methodology

The study draws on secondary and primary data sources. The authors collected secondary information from the Census of India (2001 and 2011), District Census Handbooks, District Statistical Abstracts (2020–21), and official publications from the governments of Himachal Pradesh and Uttarakhand. These sources were used to assess changes in socio-economic conditions over time. Because Census 2021 data were unavailable due to administrative delays, the temporal analysis is restricted to 2001-2011.

Primary data were collected through a structured household survey carried out between May and November 2024. In total, the study surveyed 386 households from the selected villages. Household-level surveys are useful in rural development research because they capture people's day-to-day experiences and perceptions, which official statistics or other secondary sources may not reflect (Wangdi, 2026).

To maintain consistency, the study includes only revenue villages; it excludes forest villages and the statutory town. Their administrative status and functions differ from those of revenue villages. Including them could have affected the comparison between the two study areas.

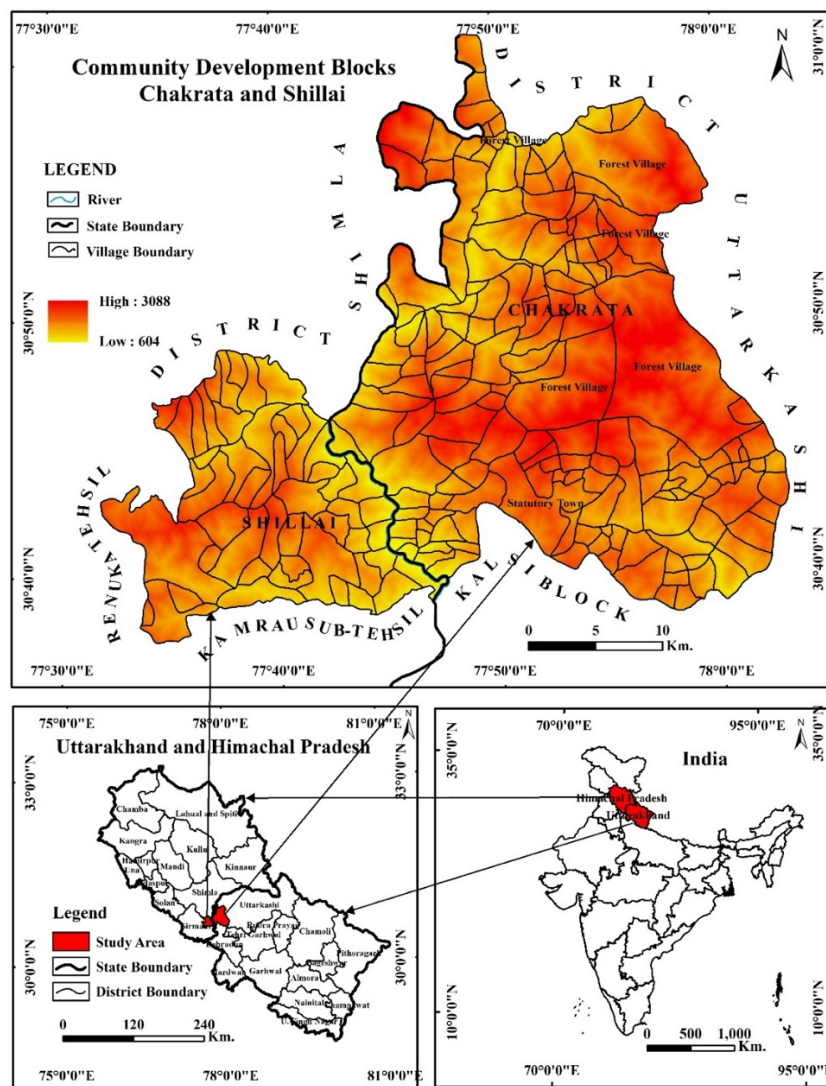


Fig. 1. Location Map of the Study Area

Source: Compiled and mapped by the authors based on the Census of India.

Standardisation of Indicators

We studied socio-economic development using 18 indicators. These indicators cover social conditions and basic infrastructure. For easier analysis, we divided them into four groups. Sex ratio and child sex ratio are components of the demographic group. Literacy includes total, male, and female literacy. The report includes three measures of work participation: total, male, and female. It also covers cultivators, agricultural labourers, household industry workers and other workers.

In the infrastructure sector, the report includes education, healthcare, transport, electricity, drinking water, and communication facilities. Using multiple indicators provides a more comprehensive picture of development. No single indicator can reflect a village's overall development status. This is particularly true in mountainous regions. Village size, employment, and access to basic services vary widely (Kreutzmann, 2001; Sati, 2015; Panakaje et al., 2025). Different units of measure were used for the indicators. Hence, they were normalised to a common form using the Z-score procedure:

$$Z = (x - \mu) / \sigma$$

where Z is the standardised score, x is the observed value, μ is the mean, and σ is the standard deviation. Standardisation placed all indicators on the same comparison scale, making integration much easier. The standardised values were then used to create an overall development score per village.

Composite Standard Score (CSS)

A Composite Standard Score (CSS) measures a composite set of items. This composite value, the Composite Standard Score (CSS), was derived by averaging the standardised score for all eighteen indicators for each village. This produced a composite index that enables comparison of overall socio-economic development across villages. Higher CSS values reflect relatively more favourable socio-economic conditions, while lower CSS values imply greater developmental disadvantage.

Sampling Framework

Villages were selected using stratified sampling to capture varying levels of development and scope types. First, villages were grouped into five clusters based on infrastructure development: very high, high, medium, low, and very low. From each infrastructure category, we randomly selected 10% of villages for the survey. This process yielded samples from 15 villages in Chakrata Block and 5 villages in Shillai Block. Based on these locations, we determined the number of households per village, for a total of 386 surveyed households across the 20 selected villages. Table 1 shows the sampled villages and surveyed households.

Table 1 Sampled Villages and Surveyed Households in the Study Area

Infrastructural Development Category	Chakrata Block- Village Name	10 per cent Sampled Households	Shillai Block- Village Name	10 per cent Sampled Households	Total sampled Households
Very High	Brinad-Bastil	37	Shillai	100	153
	Banachilar	16			
High	Mohana	16	Kando-Bhatnaul	25	51
	Mungad	10			
Medium	Luhari	9	Borar	18	77
	Malaitha	11			
	Jogyo	17			
	Kharsi	10			
	Haja	12			
Low	Raigi	25	Manal	22	89
	Bayala	9			

	Radu	13			
	Chhatad Hartad	9			
	Chatra	11			
Very Low	Jagthan	6	Sayasu	10	16
Total	15 Villages	211	5 Villages	175	386

Source: Compiled by the authors based on the methodology applied

Perception Variables

Fourteen variables were used to examine people's views on local development: Housing (X_1), Health (X_2), Sanitation (X_3), Food (X_4), Safety (X_5), Education (X_6), Status of Women (X_7), Economic Condition (X_8), Agriculture (X_9), Basic Household Amenities (X_{10}), Fuel Consumption (X_{11}), Communication (X_{12}), Transportation (X_{13}) and Political Dimension (X_{14}). These variables cover social, economic, and infrastructure-related aspects of life in rural communities.

Perception-Based Assessment

Respondents' answers were translated into a measurable index of perceived development using a Composite Index and Standard Deviation technique. Bracey (1952) suggested it, and R. L. Singh and Rana P. B. Singh (1979) revised it, as noted by Jha and Tripathi (2014). Researchers have applied it in regional development studies to translate qualitative responses into comparable quantitative measures.

This approach suits mountainous regions where regional-level aggregates may not accurately reflect village-level conditions (Kreutzmann 2001). It also aligns with recent studies in the Himalayas that have used household surveys and Likert-scale responses to gauge people's opinions on various aspects of development (Wangdi, 2026). Still, other methods used in rural settings to study household socio-economic conditions and perceptions of development are worth exploring (Panakaje et al., 2025).

Respondents rated each variable on a 5-point scale. A score of 1 meant the condition was the worst; 5 meant it was the best. For example, kuccha house received the lowest score, semi-pucca house the middle score, and pucca house the highest score in the housing variable (X_1). To standardise assessment of the variables, the same scoring method was used for each of the fourteen variables. The scores were then normalised using the min–max normalisation method:

$$\text{Normalised Value} = \frac{X - X_{\min}}{X_{\max} - X_{\min}}$$

X is the score obtained, $X_{\min}$ is the minimum score, and $X_{\max}$ is the maximum score. The scores are transformed to have a common range of 0 to 1. We then calculated average normalised values to obtain a composite perception score for each village. Higher scores indicate more positive views on development, while lower scores indicate greater dissatisfaction with local conditions. We tabulated the findings and plotted them in ArcGIS to show spatial variation in perceived development across the sampled villages.

Results and Discussions

Overall Development: A Comparative Analysis (2001-2011)

Table 2 and Figures 3 and 4 present the spatial development pattern and the number of villages in various development categories for 2001 and 2011, respectively. Based on the Composite Standard Score (CSS), villages were grouped into five development levels.

Areas of Very High Development (CSS above 0.50)

The distribution of villages in the very high development category changed clearly between 2001 and 2011 (Table 2; Figures 3 and 4). This category includes villages with relatively good socio-economic conditions and infrastructure. Chakrata Block improved significantly, with 10 villages moving into this group in 2011. Shillai Block, by contrast, had only one village in the same category. These disparities likely reflect differences in infrastructure investment, road connectivity, and access to government development programmes. These factors are particularly significant in mountainous areas, where the challenging topography may hinder access to services and economic opportunities (Devi & Tiwari, 2023). Across all villages, Lakha Mandal, Chakrata, and Shillai were in the very high development category in both 2001 and 2011. Over time, some villages moved to lower categories. This does not necessarily mean their conditions worsened, but neighbouring villages may have improved faster. Overall, Chakrata had more villages in the Very High Development category, while Shillai had relatively few villages in the study period.

Areas of High Development (CSS 0.21 - 0.50)

The number of villages in the High Development category also varied between 2001 and 2011, although the rate of development differed between the two blocks (Table 2; Figures 3 and 4). In 2001, villages were grouped under this category and showed a fairly similar level of development in both Chakrata and Shillai. The number of such villages in Chakrata decreased slightly, while in Shillai it increased by 2011. In general, villages in this category had higher literacy rates, workforce participation, and access to basic services. These outcomes appear linked to improved road infrastructure, the spread of government initiatives, and more varied livelihood options. Previous research has also emphasised these factors in improving rural development outcomes in India (Ghosh, 2017; Drèze & Sen, 2020). Others fell into the same classification because they were geographically isolated and had limited access to services and employment opportunities. Previous studies also indicate that infrastructure and connectivity are important factors influencing the development of rural mountain regions (Devi & Tiwari, 2023).

Areas of Moderate Development (CSS -0.20 - 0.20)

The moderate development category had the highest number of villages in both blocks (Table 2). This implies that many villages were at an intermediate level of socio-economic development. In the initial phase of the study period, over half of the villages in Chakrata and nearly 44 per cent in Shillai were in this category. Over time, some villages moved to higher development groups. This change was primarily linked to literacy, employment, and a decrease in gender gaps in education and employment. By 2011, 19 villages in Chakrata and 9 villages in Shillai had moved into the high or very high development categories. Despite this progress, 42 villages in Chakrata and 10 villages in Shillai remained in the moderate development group. The continued presence of many villages in this category reflects the influence of remoteness,

inadequate infrastructure, and youth out-migration. These factors often slow socio-economic improvement in Himalayan rural areas (Jodha, 2005; Karpouzoglou et al., 2020; Kreutzmann, 2001; Kumar et al., 2025).

Areas of Low Development (CSS -0.50 to -0.21)

Villages with low levels of socio-economic and infrastructural development were found in both Chakrata and Shillai blocks, though they were slightly more concentrated in Shillai (Table 2). At the beginning of the study period, this category included nearly 22 per cent of villages in Chakrata and slightly more than one-fourth of the villages in Shillai. Over time, the proportion of villages in this category declined modestly, falling to 19 per cent in Chakrata and 22 per cent in Shillai. This change is a gradual improvement in both blocks. However, the gap was wider in Chakrata, where 18 villages progressed to higher development categories, while only eight villages progressed in Shillai. Several factors still restricted development in these villages (Fig. 2 & 3). Low literacy, wide gender gaps in education and employment, moderate or low work participation, and limited agricultural improvement affected their overall progress. Some villages made progress, but their development was slower than that of others that did better. For this reason, they remained in the low development class.

Table 2: Overall Development: Comparative Analysis of Chakrata and Shillai Blocks (2001-2011)

Development Category	Name and No. of Villages			
	Chakrata		Shillai	
	2001			
Very High	Mailoth, Mohana, Lakha Mandal, Anu and Bhattar	5 (3.25)	Shillai, Gawali Pashmi and Dahar	3 (6.00)
High	Jadi, Maghgaon, Sujau, Chunauti, Jogyo, Buraswa, Rampur Sarana, Banpur, Jhitand, Bhatgarhi, Seriya, Brinad Bastil, Bagi, Maindrath, Hanol, Chatra, Raigi, Mundhola, Radu, Hartal, Katardie, Bhandroli, Silaura, Koti (Bamtad) and Tuna	26 (16.88)	Gangtoli, Bambal, Nawna Bhatwar, Kharkan, Naina, Naya Panjor, Halan, Dev Thal, and Jhakandon	9 (18.00)
Moderate	Luhari, Mungad, Sijla, Haja, Danduwa, Kitrauli, Kota, Gamari, Gawaila, Malaitha, Kandar, Majhgaon, Mendal, Sawara, Indroli, Samog, Khatuwa, Punaha Pokhari, Siribarkoti, Rangyo, Thanta, Pati, Rawana, Mahrawna, Bagoti, Shirwa, Jashta, Kota (Taplad), Kharwi, Mahpavata, Vaimoo, Kolaha, Kotuk, Silamu, Sahiya, Dhananta, Derio, Nada, Lawari, Bhatar Chhautar, Kondori Bondar, Maurhi, Dhaura Pudia, Guthar, Megar, Myvada, Kunna, Bhagawat, Meghatu, Kuna, Koti (Babar), Kanda, Chhumara, Tiutad, Purtad, Phanar, Bagoor, Obraser, Dirnad, Bhoot, Nirmaga, Chhatad Hartad, Bhunar, Kistur, Sunir, Sarni, Paturi, Eithan, Banachilar, Kunaun, Kharaura, Amarad Jhabrad, Dungri, Chanjoi, Dimich, Kaba Khera, Pinguwa, Punig, Baigi, Bulad, Undawa, Bayala, Hartar Santar, Mangtar and Masak	85 (55.20)	Milla Magnal, Ashyari, Pab (224), Bandli, Kando Bhatnaul, Shiri Kiyari, Diyandon, Bela, Matiana, Manal, Jarwa Juneli, Panog, Bindauli, Ajrouli, Borar, Bonch, Koti, Rasat, Loja Manal, Tandiyan, Darabal and Dharwa	22 (44.00)
Low	Matiyana, Sunoda, Bhoopau, Matad, Daudha, Dunwaa, Baniyana, Kiurar Khanarsichae, Kharsi, Bijanu, Kandidhar, Dawala, Bisau, Kandi Chamagata, Ninus, Derasa, Pivnal, Kulaha, Sainj, Pheirij, Chausal, Darmigar, Sunoi, Sainj, Kholara, Raitad, Penuwa, Thartha, Kunwa, Gorchha, Kandoi, Bagani, Rajanu and Buraila	34 (22.08)	Gundahan, Pab, Kota, Koti Utrou, Kuhant, Banga, Sayasu, Bobri, Chamra Morar, Bali Koti, Kinu Kulah, Jasvi and Sakhauli	13 (26.00)
Very Low	Birpa/Virpa, Chultar, Asoi and Jagthan	4 (2.59)	Kiyana, Juwan and Bindla Digwa	3 (6.00)
2011				
Very High	Maghgaon, Mahrawna, Lakha Mandal, Bhagawat, Seriya, Brinad Bastil, Hartal, Banachilar, Sunoi, Koti (Bamtad)	10 (6.49)	Shillai	1 (2.00)
High	Daudha, Sawara, Sujau, Punaha Pokhari, Pati, Rawana, Kota (Taplad), Kharwi, Sahiya, Bhatar Chhautar, Kandi Chamagata, Dhaura Pudia, Kunna, Bhatgarhi, Kanda, Raigi, Mundhola, Anu, Phanar, Dirnad, Bhattar, Dungri, Penuwa, Baigi, Bulad	25 (16.23)	Mila Magnal, Ashyari, Kuhant, Bandli, Bobri, Jarwa Juneli, Kinu Kulah, Panog, Borar, Kharkan, Naina, Rasat, Loja Manal, Darabal	14 (28.00)

Moderate	Jadi, Mungad, Matiyana, Dasson, Haja, Danduwa, Kota, Bhoopau, Gamari, Gawaila, Mailoth, Dunwaa, Malaitha, Baniyana, Mendal, Mohana, Kiurar Khanarsichae, Khatuwa, Kharsi, Siribarkoti, Rangyo, Birpa/Virpa, Chunaui, Jogyo, Thanta, Buraswa, Bagoti, Dawala, Jashta, Mahpavata, Kotuk, Silamu, Rampur Sarana, Dhananta, Derio, Nada, Lawari, Chhultar, Kondori Bondar, Guthar, Myvada, Banpur, Jhitand, Kuna, Bagi, Maindrath, Hanol, Chatra, Ninus, Koti (Babar), Chhumara, Derasa, Kulaha, Radu, Pheirij, Tiutat, Chausal, Darmigar, Purtad, Bagoor, Obraser, Bhoot, Nirmaga, Chhatad Hartad, Katardie, Kistur, Sarni, Paturi, Eithan, Sainj, Kunaun, Kharaura, Bhandroli, Silaura, Chanjoi, Dimich, Pinguwa, Kandoi, Bagani, Asoi, Hartar Santar, Tuna	82 (53.25)	Gundahan, Koti Utrou, Bambal, Pab (224), Shiri Kyari, Bela, Bali Koti, Manal, Dahar, Bindauli, Ajrouli, Jasvi, Bonch, Koti, Sakhauli, Tandiyan, Naya Panjor, Halan, Dev Thal, Jhakandon, Dharwa	21 (42.00)
Low	Luhari, Sijla, Kitrauli, Sunoda, Kandar, Majhgaon, Indroli, Samog, Bijanu, Shirwa, Vaimoo, Kolaha, Maurhi, Megar, Meghatu, Pivnal, Sainj, Bhunar, Sunir, Kholara, Raitad, Kaba Khera, Thartha, Gorchha, Punig, Undawa, Rajanu, Mangtar, Masak, Buraila	30 (19.48)	Kota, Kiyana, Juwan, Bindla Digwa, Gangtoli, Kando Bhatnaul, Banga, Sayasu, Chamra Morar, Gawali Pashmi, Matiana	11 (22.00)
Very Low	Matad, Kandidhar, Bisau, Amarad Jhabrad, Kunwa, Bayala, Jagthan	7 (4.55)	Pab, Nawna Bhatwar, Diyandon	3 (6.00)
Total Villages (2001 & 2011)		154 (100.00)		50 (100.00)

Source: Compiled and computed by the authors from Census of India data, UK and H.P. 2001 & 2011. Figures in parentheses show the percentage value of the total inhabited villages.

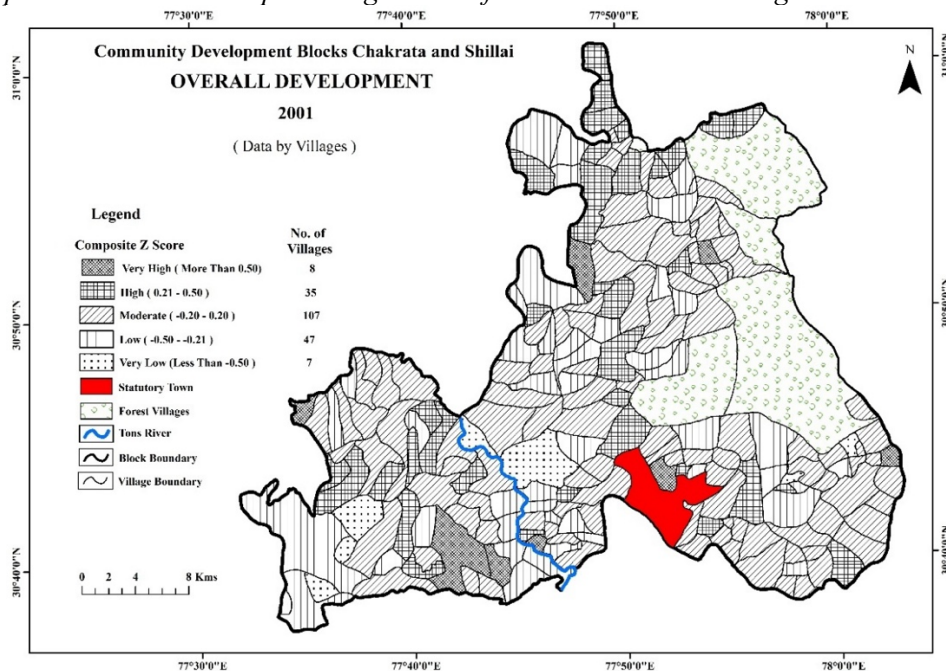


Fig. 2. Overall Development in 2001

Source: Prepared by the authors based on secondary data from the Census of India.

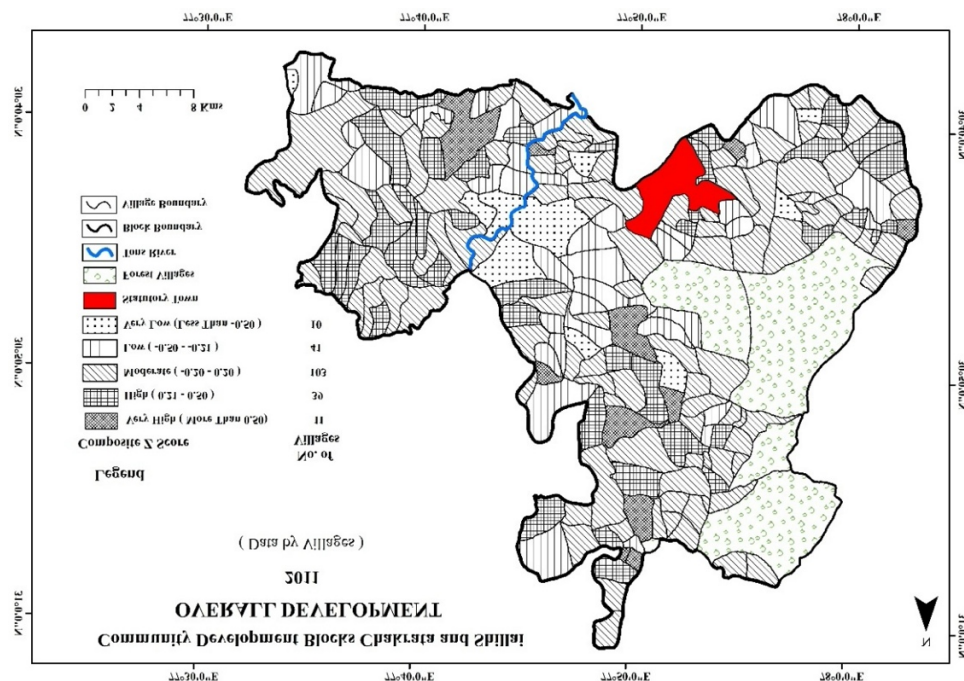


Fig. 3. Overall Development in 2011

Source: Prepared by the authors on the basis of secondary data from the Census of India

Areas of Very Low Development (CSS Less Than -0.50)

Very few villages were classified in this category, but these villages indicated the worst and most persistent levels of deprivation. Most were in areas with limited road and service access and limited markets. Overall, they had low literacy, significant gender disparities, small landholdings for farming, and few non-agricultural employment opportunities. The percentage of very low development villages increased slightly in Chakrata and remained unchanged in Shillai from 2001 to 2011. For Chakrata only, this change should not be interpreted as a deterioration of the village conditions. Instead, it indicates that other villages made greater strides and, consequently, Chakrata lost its relative standing. The backwardness of these settlements correlates with dependence on subsistence agriculture, low levels of non-farm work, youth out-migration, and low implementation of development programmes. Similar conditions have been observed in other Himalayan regions, where migration and the gradual abandonment of villages have weakened local livelihoods and reduced communities' ability to maintain agriculture and basic services (Kreutzmann, 2001; Kumar et al., 2025; Tiwari et al., 2022).

Overall, the comparison between 2001 and 2011 shows progress in both blocks, although Chakrata advanced faster than Shillai. At the same time, the large number of villages in the moderate development category shows that progress has been uneven and that many settlements are still in a transitional stage. The next section complements this census-based assessment by examining how residents perceive development in their own villages.

People's Perception of Overall Development: A Comparison of Chakrata and Shillai Blocks

After examining development through Census-based indicators, the study also considered local residents' views using data from the household survey. The study calculated a composite perception score for each of the 20 sampled villages using fourteen indicators (Table

3). The mean score was 21.10, with a standard deviation of 1.28. These scores were then used to categorise villages according to their perceptions of development into five categories (Table 3).

There was no village in either block in the very high development. This finding reflects ongoing problems in mountain communities rather than a data limitation. Socio-economic indicators were improving in certain villages, but everyday life and livelihoods still face difficult terrain, poor accessibility, inadequate services, and limited livelihood opportunities (Jodha, 2005; Karpouzoglou et al., 2020). It also suggests a disconnect between residents' perceptions and the positive outcomes of infrastructure improvements. A person's satisfaction depends on the facility's availability in remote rural areas, as well as its quality, regularity, affordability, and accessibility. Other geographically isolated rural communities have been found to experience similar situations (Bernard, 2018; Bhattacharyya et al., 2021). Research on community participation and rural development also indicates that infrastructure investments are not sufficient to ensure development results. Development is meaningful only if residents experience real improvements in their social and economic status (Wangdi, 2026). Two villages scored high: Brinad Bastil in Chakrata Block and Shillai in Shillai Block. Residents in these villages had relatively good access to infrastructure and public services, as shown by their higher composite scores and more positive responses.

Most sampled villages fell in the Moderate range. This group included 13 villages from Chakrata and 3 from Shillai. However, these villages had experienced a mixed picture in some areas, for example, in education, roads or basic facilities, while other areas had not. Only one village in Chakrata and none in Shillai fell into the Low category. This means that while development in the villages is still uneven and incomplete, most sampled villages did not experience poor conditions across all fourteen indicators. Only one village (Sayasu, Shillai Block) was classified as Very Low. The village is a concentrated area of disadvantages, including a lack of infrastructure, limited access to essential services, and its geographical location. The location is indicative of intra-regional differentials in development, as earlier studies on the differentials in mountain areas suggested (Sati, 2015 and Sharma, 2019).

A comparison of the two blocks indicates that Chakrata is in a better position than Shillai. Both blocks have 1 Village in the High development category, but Chakrata has no village in the Very Low category, whereas Shillai has 1 village in the Very Low category. Despite this disparity, the overall pattern is similar in both blocks. No village could be termed very highly developed, and most villages were in the Moderate category. This indicates that, although basic facilities and development initiatives have improved in many places, residents do not always experience these changes as a substantial improvement in their everyday lives.

Table 3. Levels of Development based on People's Perception

Levels of Socio-Economic Development	Statistical Value	Composite Score	Name of the Villages	
			Chakrata	Shillai
Very High	Mean + 2 SD and above	≥ 23.66	-	-
High	Mean + 1 SD to Mean + 2 SD	22.38 – 23.65	Brinad Bastil	Shillai

Levels of Socio-Economic Development	Statistical Value	Composite Score	Name of the Villages	
			Chakrata	Shillai
Moderate	Mean -1 SD to Mean + 1 SD	19.82 – 22.37	Raigi, Mohana, Haja, Mungad, Banachilar, Byala, Jagthan, Malaitha, Kharsi, Radu, Jogyo, Chhatad-Hartad, Chatra	Borar, Kando Bhatnaul, Manal
Low	Mean - 2 SD to Mean -1 SD	18.54 – 19.81	Luhari	-
Very Low	Below Mean - 2 SD	< 18.54	-	Sayasu

Source: Computed by the authors based on composite score value from field survey May to November, 2024.

This, therefore, is the gap between actual development and people's perception. The same has been observed in other rural areas (Bernard, 2018). Beltramo et al. (2024) studied the relationship between infrastructure and satisfaction and well-being in a rural mountainous region in Italy and found no direct correlation. They also found that low quality of life can lead to depopulation and further slow local development. Wangdi (2026) reported a similar scenario in Bhutan, where residents described development projects as only 'somewhat successful' even when they were implemented on time. The results indicate that development should not be limited to the construction of roads, buildings and other physical structures. It should also be accessible to people, used regularly, and have a real impact on their day-to-day lives.

Conclusion

This study analysed the socio-economic development of the villages of Chakrata and Shillai blocks at the local and spatial levels. It also examined differences between the changes shown in secondary data and local people's views of development in their own villages. The findings show improvements in both blocks, but also show differences between measured improvement and what people experience in their day-to-day lives, and between villages. In both 2001-2011, Chakrata and Shillai showed improvement in development. But the progress was more widespread and rapid in Chakrata. The block had more villages in the very high development category and fewer in the lowest development category. The improvement was less pronounced even in Shillai. Very few villages attained the highest level, and some continued in the very low development group. The highest number of villages in both blocks was in the moderate development category. This indicates that things have improved, but many settlements still lag behind what might be considered satisfactory across all dimensions. Progress has been driven by rising literacy, increasing labour market participation, better road infrastructure, and expanded government schemes. Meanwhile, several villages were adversely affected by poor infrastructure, limited non-farm employment, out-migration, and remoteness. The type of distress-induced migration reported here is comparable to that in other parts of the Indian Himalayan Region (Kumar et al. 2025).

These results are supplemented by the perception-based assessment. No village had a high perception rating in any of the very high categories. Overall, villagers in relatively successful villages were moderately satisfied with local development. Dissatisfaction was

greater in more remote villages where access to services and opportunities was less good. This implies that a road, school, health centre or government programme does not necessarily mean an improved quality of life. Development must involve people being able to access services regularly, access markets, and have stable income and security in their everyday lives. Many of these are challenging for households in the study area. Other authors, such as Beltramo et al. (2024), also highlight that quality of life in rural areas has multiple aspects and must be supported by local-level indicators to identify areas where it is low. However, Tiwari et al. (2022) note that the income benefits of migration are not always associated with reduced inequality within rural communities. The evidence identifies some policy priorities. Enhancing connectivity via roads is particularly crucial, as it affects access to education, healthcare, markets, employment and public services. Livelihood programs are also needed, especially in villages where young people have already started moving to seek employment. Less developed and distant settlements also need further development of education and health services. Government schemes need closer monitoring to ensure benefits are delivered in a timely fashion and as intended to isolated villages.

Overall, the study illustrates the need for local, place-based planning in mountain development. Plains or urban policies may not suit mountain communities because the physical landscape, elevation, climate, and isolation significantly affect daily life. Local geographical conditions and community needs should therefore inform development plans in the western Himalayas. Local quality-of-life indicators, as proposed by Beltramo et al. (2024), can help identify gaps that overall development statistics might miss. Kreutzmann (2001) also emphasises the need for sub-regional indicators when distinguishing true differences within mountain regions.

The study has a couple of limitations. Because Census 2021 data were unavailable, the temporal analysis was limited to 2001-2011. Consequently, it was not possible to adequately evaluate recent changes in village-level development. Forest villages and the statutory town were also excluded from the study, so the results apply only to the selected rural settlements. Future studies should use the latest primary household data and include more blocks across the Western Himalayan region. These studies will help ascertain whether the observed patterns are particular to the blocks of Chakrata and Shillai or common across the region. The indicators can be extended to include environmental change, vulnerability to environmental change, disaster risk, digital access, and the impacts of migration on household well-being.

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*Article***A Geographical Study of Rural Community Health Problems in Development Block Betalghat, Kumaon Lesser Himalaya***Dheeraj Pant^{1*}, Sunil Tewari¹, Mohan Singh Sammal¹, Ranju Joshi Pandey²**¹Department of Geography & NRM, School of Earth and Environmental Science, Uttarakhand Open University, Haldwani, Nainital, Uttarakhand, India.**¹Department of Geography & NRM, School of Earth and Environmental Science, Uttarakhand Open University, Haldwani, Nainital, Uttarakhand, India.**¹Department of Geography & NRM, School of Earth and Environmental Science, Uttarakhand Open University, Haldwani, Nainital, Uttarakhand, India.**²Department of Remote Sensing & GIS, School of Earth and Environmental Science, Uttarakhand Open University, Haldwani, Nainital, Uttarakhand, India.***Email: dheerajpant@uou.ac.in*

Abstract: In the 21st century, basic healthcare remains a major challenge in the Himalayan region. This study aims to assess the status of health services in the Betalghat development block, identify key issues related to rural healthcare, examine the geographical and socio-economic factors influencing community health, and suggest measures to improve the accessibility and delivery of health services. Primary data were collected through questionnaires, interviews with key informants, focus group discussions, and empirical observations on respondents' age structure and socio-economic status. Participants included health workers (ASHA, ANM), local traditional healers, and government and non-government healthcare providers (doctors/pharmacists). Secondary data were gathered from various government offices and healthcare centres (CHC, PHC, Sub-C, & Anganwadi Centres). Study findings indicate that the primary barriers to accessing basic health services include poor socio-economic status, inadequate health infrastructure, a severe shortage of health workers, a poor transport system, and difficult geographical terrain; among these, the shortage of health workers (29%), poor infrastructure (22%), and poor accessibility (20%) stand out as the most significant health challenges. As with other plain regions, strengthening basic rural health infrastructure, improving transport and emergency services, ensuring the adequate deployment of healthcare professionals, and expanding financial protection mechanisms are essential to fostering accessible and sustainable healthcare development.

Keywords: Rural community; Health services; Socio-economic status; Kumaon Himalaya.

Introduction

Every state and nation has an obligation to uphold every citizen's fundamental right to good health and to ensure the public has easy access to basic healthcare services. According to the 2021 census, India's population is approximately 1.43 billion (142.86 crore). The 2011 Population Census counted 1.21 billion (121 crore or 1210 million) people, with 833 million (68.84%) living in rural areas and 377 million (31.16%) in urban areas. Most people live in rural areas. Despite this demographic reality, healthcare infrastructure remains disproportionately concentrated in metropolitan areas. A United Nations report states that almost 75% of India's medical facilities, including hospitals, doctors, and specialists, are found in cities. India has implemented numerous health policies, initiatives, and strategic plans to improve public health more than 70 years after gaining independence. Despite significant economic expansion, public health remains a significant developmental obstacle. Similarly, global initiatives like the World Health Organisation's Health for All campaign, the Millennium Development Goals, Universal Health Coverage, and the Sustainable Development Goals—especially the objectives of guaranteeing healthy lives and promoting well-being for all at all

ages—have not been fully translated into successful grassroots implementation. As a result, access to, use of, and quality of public healthcare services remain major issues, especially in rural India. The World Health Organisation advises nations to devote roughly 5% of their GDP to the health sector. However, India's health spending remained much lower, at only 3.3% of GDP in 2019–20 (National Health Accounts, 2023). Rural populations that are economically and socially disadvantaged and heavily dependent on government health services are disproportionately affected by low public healthcare expenditure. Access to basic healthcare facilities has also been influenced by the growing commercialisation and privatisation of health services. A large section of the population is deprived of essential services because high treatment costs at private healthcare facilities make quality medical care unaffordable for low-income households. In terms of healthcare services, Uttarakhand faces significant challenges compared with other Himalayan states. Primary Health Centres (PHCs), which are the initial point of contact for basic healthcare, are severely lacking in the state. About 68% of district hospitals lack specialised physicians, while about 70% of PHCs lack a Medical Officer. These problems seriously restrict access to and the quality of healthcare, particularly in remote and hilly regions. The study region reflects many of these broader structural problems. A fragile and complex system results from several factors, including harsh weather and geographic conditions, low socioeconomic status, poor nutrition, environmental degradation (including air, water, and noise pollution from increased human intervention), declining agricultural productivity, and inadequate physical infrastructure. These interrelated issues compound each other, increasing the community's risk of unfavourable outcomes and further limiting access to quality healthcare facilities.

This paper evaluates the Batalghat Development Block's healthcare infrastructure, addresses the main health issues in rural areas and investigates the socioeconomic and geographic elements affecting healthcare access and health outcomes. Based on these findings, it recommends actions and legislative changes to improve the quality, accessibility, and availability of rural healthcare services.

Study Area

Geographically, Batalghat Block lies predominantly within the Lesser Kumaon Himalayas. It extends between 29°22'30" and 29°37'00" N latitude and 79°12'00" and 79°35'00" E longitude. The study region covers a total area of 315.7 km². According to the 2011 Census of India, the block's total population is 41,535, comprising 20,518 males (49.40%) and 21,017 females (50.60%). The average is 131 people per km². The Batalghat Block, characterised by steep surface slopes and geotectonic instability, displays tremendous geomorphologic diversity and climatic variation. It is also one of the relatively densely populated regions of the Lesser Himalayas, where subsistence agriculture and animal husbandry constitute the primary sources of food security and rural livelihoods.

Research Methodology

This study used questionnaires, key informant interviews, and focus group discussions to assess the local community's health status, rural health problems, and the state of health services and infrastructure. Primary data collection was based on the respondents' age structure, socio-economic status, and empirical observation. Respondents primarily included the elderly (over 60 years of age), experienced individuals, and rural women, along with health workers (ASHA, ANMs), local Vaidyas, and government and non-government health service providers (doctors/pharmaceuticals). Data on the state of health infrastructure, the status of health service providers, the availability of health services, and key health schemes in the study area were

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collected from various government offices, hospitals (community health centres, primary health centres, and sub-centres).

Community Health Problems in Development Block Betalghat

Table 1 presents the questions asked to local people about major health-related problems and the respondents' responses.

Table 1: Health-Related Major Problems

S. No.	Major Problems	Percent (%)
1.	Poor Accessibility	20
2.	Weak Healthcare Infrastructure	22
3.	Severe Shortage of Medical Staff	29
4.	High Maternal and Child Health Risks	11
5.	Economic Hardship and Out of Pocket Costs	18

According to respondents, major health problems in the study area include: 20% agreed on poor accessibility, 22% on weak health infrastructure, 29% on a severe shortage of medical staff, 11% on high maternal and child health risks, and 18% on economic hardship and out-of-pocket costs.

Poor Accessibility

In response to challenges related to access to health services, 20% of respondents stated that access to healthcare in the area remains difficult for the general public. Many villages (Gram Sabhas) still lack road connectivity; residents must first walk 2–5 km to reach the metalled road and then take shared taxis for 20–25 km to reach the community health centres. During the monsoon season, heavy rainfall disrupts roads, bridges, and other infrastructure, directly affecting rural community health services and making emergency treatment (accidents and labour pain in pregnant women, etc.) more critical (Fig. 1&2).

Weak Health Infrastructure

Regarding the physical infrastructure for health services, 22% of respondents acknowledged a lack of it in the study area. The survey found two community health centres, five primary health centres, and 19 sub-health centres in the study area. Of these, only 60% of primary health centres have physician accommodations; none of the primary health centres in the study area has nurse or pharmacist accommodations. In the study area, only 60% of Primary Health Centres have an electricity supply. In the event of a power outage, no Primary Health Centre possesses any alternative resource (such as a generator, solar light, etc.). 40% of Primary Health Centres lack any water supply facilities, while the water supply in 20% of the centres is damaged. Given this situation, one can easily identify the actual condition of hygiene and sanitation facilities—specifically toilets—within these health centres. Furthermore, because of the challenging terrain in the study area, the '108' emergency health service is often unavailable on time. Moreover, most Sub-Health Centres lack basic amenities such as normal delivery kits and stretchers; Primary Health Centres lack delivery kits, deep freezers, and wheelchairs; and Community Health Centres lack anaesthesia equipment and blood transfusion apparatus (Table 2).



Fig. 1: Collapsed Bridge, Source: Google
Source: Open access social media



Fig. 2: Carrying Patient to Hospital (CHCs),

Table 2: Status of Basic Health Infrastructure in Community Health Centres in Betalghat Development Block

S.No.	Infrastructure	Community Health Centre			
		Betalghat		Garampani	
		Available	Unavailable	Available	Unavailable
1.	Own Building	Yes	-	Yes	-
2.	Doctor's Residence	Yes	-	Yes	-
3.	Nurses' and Pharmacist's Residence	Yes	-	Yes	-
4.	Electricity Supply	Yes	-	Yes	-
5.	Water Supply	Yes	-	Yes	-
6.	Generator	Yes	-	Yes	-
7.	Toilets	Yes	-	Yes	-
8.	Fully Equipped Laboratory	Yes	-	Yes	-
9.	Blood Bank	-	No	Yes	-
10.	Vehicle	Yes	-	Yes	-

Source: Field Survey

Table 3 shows the status of basic health infrastructure in the Community Health Centres (CHCs) of Betalghat and Garampani Development Blocks. Both CHCs have almost all essential facilities, including their own building, a doctor's residence, nurses' and pharmacists' residences, electricity, water supply, a generator, toilets, a fully equipped laboratory, and a vehicle. However, the Betalghat CHC lacks a blood bank, while the Garampani CHC has one. Overall, the findings indicate that both CHCs are well equipped with basic health infrastructure, with the only notable gap being the absence of a blood bank at Betalghat CHC.

Table 3: Status of Basic Health Infrastructure in Primary Health Centers in Betalghat Development Block

Name of Nyaya Panchayat	Name of primary health center	Own House	Doctor residence	Nurse and Pharmacist Accommodation	Power Supply	Generator	Water Supply	Reading Room	Boundary Wall
Betaalghat	Kalakhet	Yes	Yes	No	No	No	Partial	Yes	No
Dadima	Sukhadankholi	Yes	Yes	No	Yes	No	No	Partial	Partial
	Uchakot	Yes	Yes	No	No	No	Partial	Partial	Partial
Simalkhan	Simalkhan	Yes	Yes	No	Yes	No	Yes	Yes	No
Garampani	Dhaniyakot	Yes	Yes	No	Yes	No	Yes	Partial	Partial

Source: Field Survey

According to the report, all PHCs have their own buildings and physician houses, suggesting adequate physical infrastructure. Overall, none of the PHCs provides the required accommodations for nurses and pharmacists, a serious shortcoming that affects medical personnel availability, especially outside regular business hours and during emergencies. Basic facilities aren't always easily accessible. Sukhadankholi, Simalkhan, and Dhaniyakot PHCs have electricity; however, Kalakhet and Uchakot PHCs do not. Healthcare services are vulnerable to power outages because none of the PHCs has generator facilities. Only Simalkhan and Dhaniyakot PHCs have full access; Kalakhet and Uchakot have partial access, and Sukhadankholi has no regular water supply.

Supportive infrastructure also has serious issues. Only the PHCs in Kalakhet and Simalkhan have fully functional reading rooms; the other facilities are only partially furnished. Concerns remain about maintenance and security because boundary walls are either nonexistent or only partially constructed in all PHCs.

Overall, the chart shows that significant problems remain with staff accommodation, backup power, water supply, and supporting facilities, even though PHCs have only the barest minimum of structural infrastructure. These infrastructure defects may negatively affect the quality, effectiveness, and continuity of basic healthcare services in the Betalghat Development Block.

Table 4: Status of basic health infrastructure in health sub-centres in development block Betalghat

Name of the Nyaya Panchayat	Name of Primary Health Center	Own Building	Rented Building	A.N.M. Residence	Power supply	Generator	Water Supply	Reading Room	Boundary Wall
Betalghat	Kalakhet	Yes	-	No	Yes	No	Yes	Yes	
	Binkot	Yes	-	No	Yes	No	Partial	Partial	No
	Naughar	Yes	-	No	Yes	No	Partial	Partial	No
	Betaalghat	Yes	-	No	No	No	No	No	Yes

	Talliseti	Yes	-	No	No	No	Yes	Yes	No
	Malliseti	Yes	-	No	Yes	No	Yes	Yes	Yes
Dadima	Darima	Yes	-	No	Yes	No	Partial	Partial	Yes
	Sukhdankh oli	Yes	-	No	Yes	No	Partial	Yes	No
	Uchhakot	Yes	-	Yes	Yes	No	Partial		Yes
	Tiwari Gaon	Yes	-	Yes	Yes	No	Yes	Yes	Yes
Simalkha	Simalkha	Yes	-	No	Yes	No	Partial	Partial	Yes
	Khairalibun ga	Yes	-	Yes	Yes	No	Yes	Yes	No
Garampani	Garampani	Yes	-	No	Yes	No	Yes	Yes	Yes
	Dhaniyakot	Yes	-	No	Yes	No	Yes	Yes	Yes
	Lohali	Yes	-	No	Yes	No	Partial	Yes	Yes
Ghangharet i	Chandrakot	-	Yes	No	No	No	No	No	Yes
	Thapli	Yes	-	No	No	No	Yes	Yes	No
Ratighat	Ratighat	Yes	-	No	Yes	No	Yes	Partial	No
	Niglat	Yes	-	No	Yes	Yes	Yes	Yes	No

Source: Field Survey

Table 4 shows the condition of basic health infrastructure in 18 Health Sub-Centres across the Betalghat Development Block. With 17 sub-centres operating from their own buildings and only Chandrakot operating from a rented building, the results show sufficient permanent infrastructure. A.N.M. dwellings are found in only three sub-centres (Uchakot, Tiwari Gaon, and Khairalibunga); the absence of residential facilities in the other centres may adversely affect staff availability and emergency medical services.

Basic amenities are inconsistently available. While Betalghat, Talliseti, Chandrakot, and Thapli lack power, most sub-centres do. Because most centres lack generators, they are vulnerable to service interruptions during power outages, as only Niglat has a generator. The fact that water supply is sufficient in some places, partially available in others, and nonexistent in Betalghat and Chandrakot demonstrates disparities in access to fundamental amenities. Overall. Although most Health Sub-centres have permanent buildings, the lack of A.N.M. housing, backup power, adequate water supply, and security infrastructure reveals significant infrastructural deficiencies. These drawbacks highlight the need for focused infrastructure development and are expected to reduce the efficacy, accessibility, and quality of essential healthcare services in the Betalghat Development Block.

Severe Shortage of Medical Staff

A community's ability to maximise its health depends on its medical personnel. Through screenings, vaccinations, and health education, they help prevent disease, manage chronic illnesses, offer early detection and medical attention, and give emergency care. Areas with enough trained healthcare providers typically have higher life expectancy, better health outcomes, and lower death rates. Conversely, a lack of medical personnel can lead to poorer health and limited access to high-quality healthcare. This study uses secondary data, and field observations indicate that the research location severely lacks medical personnel. In violation of Indian Public Health Standards, over 29% of respondents admitted a significant scarcity of healthcare professionals, including specialists, general practitioners, gynaecologists, health supervisors, cleaners, and other workers.

Table 5: Status of healthcare providers at Community Health Centres in Betalghat Development Block

S. No.	Name of Cadre	Details of Staff at the Community Health Centres					
		Betalghat			Garampani		
		Sanctioned Posts	Incumbents	Vacant Posts	Sanctioned Posts	Incumbents	Vacant Posts
1.	Medical Superintendent	01	01	00	01	01	00
2.	Public Health Specialist / Other Specialist	01	00	01	01	00	01
3.	General Surgeon	01	00	01	01	00	01
4.	Physician	01	00	01	01	00	01
5.	Gynecologist	01	00	01	01	00	01
6.	Pediatrician	01	00	01	01	00	01
7.	Anesthetist	01	00	01	01	00	01
8.	Medical Officer	02	05	00	02	02	00
9.	Dental Surgeon	01	00	01	01	00	01
10.	Chief Pharmacist	01	00	01	01	00	01
11.	Pharmacist	01	01	00	01	00	01
12.	X-ray Technician	01	01	00	01	01	00
13.	Dental Hygienist	01	01	00	01	01	00
14.	Nurse	01	00	01	05	05	00
15.	Nursing Officer	05	04	01	05	05	00
16.	Laboratory Technician	01	01	00	01	00	01
17.	Laboratory Assistant (Rural)	01	00	01	01	00	01
18.	Health Inspector	03	00	03	01	00	01
19.	Health Supervisor	05	00	05	05	00	05
20.	Health Worker (Male)	09	00	09	09	00	09
21.	Health Worker (Female)	01	01	00	01	01	00
22.	Senior Assistant	01	01	00	01	01	00
23.	Junior Assistant	01	01	00	01	00	01
24.	Vehicle Driver	01	01	00	01	00	01
25.	Class IV Staff	07	01	06	05	01	04
26.	Cleaner	03	00	03	02	00	02
Total		53	19	37	52	18	34

Source: Field Survey

Table 5 reveals that the Betalghat Development Block's Community Health Centres (CHCs) are severely understaffed. Only 19 of the 53 available posts at Betalghat CHCs are filled (35.8%), leaving 34 openings (64.2%). Similarly, only 18 of the 52 positions at Garampani CHC are filled (34.6%), while 34 are empty (65.4%). Human resources are severely lacking because only 37 of the 105 allowed positions at the two CHCs are filled (35.2%),

leaving 68 open (64.8%). Because 100% of the approved positions for Public Health Specialists, General Surgeons, Physicians, Gynaecologists, Paediatricians, Anaesthetists, and Dental Surgeons remain unfilled in both CHCs, the shortfall is most acute among specialist physicians. This acute lack of experience severely limits CHCs' ability to provide referral, emergency, and speciality healthcare services. Technical, paramedical, and field-level staff are severely lacking, even though administrative positions such as Medical Superintendents (100% filled) and Medical Officers (100% in Betalghat and 100% in Garampani) are mostly filled. Male health professionals at Betalghat CHC have a 100% vacancy rate, while class fourth staff have an 85.7% vacancy rate. Similar shortcomings exist at Garampani CHC, where laboratory assistants, pharmacists, health supervisors, male health workers, and other specialised professions have 100% vacancies. Cleaners, drivers, and laboratory technicians are among the roles that remain unfilled.

The statistics show that over two-thirds (64.8%) of sanctioned healthcare positions are unfilled, adversely affecting the operational capacity of both Community Health Centres. The severe shortage of experts, paramedics, field workers, and support personnel is expected to compromise the quality, accessibility, effectiveness, and continuity of healthcare services in the Betalghat Development Block. These results highlight the need to improve the rural healthcare system through equitable staffing, targeted hiring, and effective retention strategies.

Table 6: Healthcare providers' status in Primary Health Centres in Development Block Betalghat

Name of Nyaya Panchayat	Name of Primary Health Centre	Status of Healthcare Workers						
		Total Sanctioned Posts Medical Officer	Medical Officer	Pharmacist	A.N.M.	Class IV Staff	Cleaner	Vacant posts
Betalghat	Kalakhet	05	00	01	00	00	00	04
Dadima	Sukhadankholi	05	00	01	00	00	00	04
	Unchakot	05	01	01	00	00	00	03
	Simalkhan	05	00	01	00	01	00	03
Simalkha	Dhaniyakot	05	00	01	00	00	00	04
Betalghat Development Block		25	01	05	00	01	00	18

Source: Field Survey

Table 6 shows that the five Primary Health Centres (PHCs) in the Betalghat Development Block are severely understaffed. Of the 25 sanctioned posts, just 7 are filled (28.0%), leaving 18 unfilled (72.0%). This indicates that more than three-fourths of the authorised workforce is unavailable. According to the staffing pattern, just one medical officer is available out of five sanctioned posts (20.0%), leaving 80.0% of medical officer positions vacant. Pharmacists are now fully staffed, with all five allowed posts filled (100%). Nevertheless, each PHC has only one fourth-class employee and no Auxiliary Nurse Midwives (ANMs) or cleaners, meaning ANMs and cleaners are 100% vacant and fourth-class staff are only 20% filled.

At the individual PHC level, Kalakhet, Sukhadankholi, and Dhaniyakot each have one employee (20% of sanctioned strength), whereas Uchakot and Simalkhan each have two employees (40% of sanctioned strength). Consequently, the vacancy rates at the PHCs range from 60% to 80%. Overall, the findings demonstrate how seriously understaffed the Primary Health Centres in the Betalghat Development Block are. Although pharmacist positions are fully staffed, the severe shortage of Medical Officers, the complete absence of ANMs and cleaners, and the inadequate availability of support workers are expected to negatively affect

the accessibility, effectiveness, and quality of primary healthcare services. These findings show the importance of equitably hiring and distributing healthcare staff to strengthen the PHC system.

Table 7: Status of Health Workers at Health Sub- centres in Betalghat Development Block

Name of the Nyaya Panchayat	Sub-center	Status Of Health Workers				
		Pharmacist	M.L. H.P. / CHO	Health Worker (Female)	Sanctioned Posts	Vacant Posts Relative to Sanctioned Posts
Betaalghat	Kalakhet	00	00	01	03	02
	Binakot	00	01	01	03	01
	Naughar	01	01	01	03	00
	Betaalghat	00	01	00	03	02
	Talliseti	00	00	01	03	02
	Malliseti	01	01	01	03	00
Dadima	Darima	00	01	00	03	02
	Sukhadankholi	00	00	01	03	02
	Uchhakot	00	00	01	03	02
	Tiwari Gaon	00	01	00	03	02
Simalkha	Simalkha	00	00	01	03	02
	Khairalibunga	00	01	00	03	02
Garampani	Garampani	00	00	00	03	03
	Dhaniyakot	00	00	01	03	02
	Lohali	01	01	01	03	00
Ghanghareti	Chandrakot	00	01	01	03	01
	Thapli	00	01	01	03	01
Ratighat	Ratighat	01	01	01	03	00
	Niglat	00	01	01	03	01
Betalghat Development Block		04	12	14	57	27

Source: Field Survey

Table 7 reveals a considerable shortage of health workers across the 19 Sub-centres in the Betalghat Development Block. Against a total of 57 sanctioned posts (3 posts per sub-centre), only 30 posts are filled (52.6%), while 27 posts remain (47.4%). Thus, nearly one-half of the sanctioned workforce is unavailable, which may adversely affect the delivery of primary healthcare services. Among cadres, Female Health Workers (ANMs) show the highest availability, with 14 of 19 posts filled (73.7%), leaving 5 vacancies (26.3%). Multi-Purpose Health Workers/Community Health Officers (MLHP/CHO) have 12 filled posts (63.2%), while 7 posts (36.8%) remain vacant. In contrast, Pharmacists are available in only 4 sub-centres (21.1%), leaving 15 vacancies (78.9%) and indicating a severe shortage of pharmaceutical personnel. At the sub-centre level, Malliseti, Naughar, Lohali, and Ratighat are fully staffed, with 100% of sanctioned posts occupied, whereas Garampani Sub-centre has the poorest staffing, with only one of three sanctioned posts filled (33.3%) and 66.7% vacancies. Most other sub-centres have only one or two staff members, resulting in vacancy rates ranging from 33.3% to 66.7%.

Overall, the findings indicate that although the availability of Female Health Workers and Community Health Officers is relatively satisfactory, the acute shortage of Pharmacists and the high overall vacancy rate (47.7%) weaken Health Sub-centre functioning. These human resource gaps are likely to reduce the accessibility, continuity and quality of primary healthcare

services in the Betalghat Development Block, highlighting the need for urgent recruitment and equitable deployment of health personnel.

High Maternal and Child Health Risks

In medical institutions, supervision by medical professionals and adequate equipment reduce maternal and infant mortality rates and help ensure safe, healthy deliveries. During the survey, 11% of respondents acknowledged that maternal and child health is a serious social and health-related challenge in the study area. Inaccessible geographical conditions, a scarcity of health facilities, economic backwardness, and a lack of awareness adversely affect the health of women and children in this region. There is a shortage of specialist doctors-particularly female specialists-at the Community Health Centres and Primary Centres (Maternity Centres) within the area. Consequently, residents must travel to larger cities to access better Maternal and Child Health care services.

Table 8: Status of Health Equipment in Community Health Centres in Betalghat Development Block

S. No.	Health Equipment	Community Health Centre			
		Betalghat		Garampani	
		Available	Unavailable	Available	Unavailable
1.	Standard Surgical Kit-1	Available	-	Available	-
2.	Standard Surgical Kit-2-5	Available	-	Available	-
3.	Contraception Kit	Available	-	Available	-
4.	Normal Delivery Kit	Available	-	Available	-
5.	Anesthesia Equipment	-	Unavailable	-	Unavailable
6.	Neonatal Resuscitation Equipment	Available	-	Available	-
7.	Blood Transfusion Equipment	-	Unavailable	-	Unavailable
8.	Vaccination Equipment	Available	-	Available	-

Source: Field Survey

Table 8 presents the availability of essential health equipment in the two Community Health Centres (CHCs) of Betalghat and Garampani. The findings indicate that both CHCs possess 6 out of 8 essential categories of health equipment (75%), while 2 categories (25%) are unavailable. Both centres stock sufficient equipment for family planning, immunisations, minor surgical procedures, and routine maternal and child healthcare services, including Standard Surgical Kits (Kit-1 and Kit-2.5), Contraception kits, Normal Delivery kits, Neonatal Resuscitation Equipment, and Vaccination Equipment.

However, anaesthesia and blood transfusion supplies are totally unavailable at both CHCs. CHCs' ability to handle obstetric crises, trauma patients, and severe anaemia is severely hampered by the lack of blood transfusion equipment, while the absence of anaesthesia equipment makes it challenging for them to perform emergency and major surgical procedures. As a result, patients needing advanced emergency care must be sent to more modern medical institutions, raising treatment costs and causing delays.

Overall, the analysis shows that while 75% of necessary medical equipment is available, the lack of 25% of vital life-saving equipment significantly impairs both Community Health Centres' ability to provide comprehensive services and to prepare for emergencies. The quality, accessibility, and efficacy of secondary healthcare services in the Betalghat Development Block will be greatly enhanced by fortifying these institutions with anaesthetic and blood transfusion equipment.

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Table 9: Status of Equipment in Primary Health Centres in Betalghat Development Block

Name of the Nyaya Panchayat	Name of primary health center	Health Equipment										
		Weighing-Machine	Delivery kit	BP Measuring Instrument	Deep Freezer	Hemoglobin Meter	Oxygen Meter	Wheel chair	Stretcher	Sterilizer	Citizen Charter	Sign board
Betalghat	Kalakheth	A	U	A	U	A	A	U	U	A	U	A
Dadima	Sukhadan kholi	A	U	U	U	A	A	A	A	A	U	A
	Uchakot	A	U	U	U	A	A	U	U	U	U	A
Simalkha	Simalkhan	U	A	U	U	A	A	U	U	A	A	A
Garampani	Dhaniyakot	U	U	U	U	A	A	U	U	A	U	A

Source: Field Survey

Table 9 lists the ten necessary medical supplies that are available at each of the five Primary Health Centres (PHCs) in the Betalghat Development Block. The research shows that more than half of the necessary equipment is missing: out of 50 equipment units (10 equipment $\times$ 5 PHCs), 23 units are available (46%), and 27 units are absent (54%).

All five PHCs (100%) have oxygen and haemoglobin meters, indicating adequate capacity for basic diagnostics and patient monitoring. In most centres, four PHCs (80%) have sterilisers and three PHCs (60%) have drugs that aid in infection management. Nevertheless, none of the PHCs has deep freezers, which can be detrimental to vaccine storage and cold chain upkeep. Similarly, only one PHC (20%) has wheelchairs, citizen charter boards, and BP meters, suggesting serious deficiencies. Only one delivery kit is available. Three PHCs (60%) have sign boards; however, only one PHC (20%) has stretchers, which limits emergency and maternal healthcare services. Sukhadankholi has the most equipment at the PHC level (7 out of 10 items, or 70%), followed by Kalakheth (60%), Simalkhan (50%), Uchakot (30%), and Dhaniyakot (30%). This suggests substantial differences in how PHCs distribute essential medical equipment. Although basic diagnostic tools like oxygen and haemoglobin meters are widely available, the results indicate that only 46% of equipment is available overall, with significant shortages in cold-chain, emergency, maternal care, and transportation. These shortcomings are expected to reduce the effectiveness, responsiveness, and quality of primary healthcare services in the Betalghat Development Block, underscoring the need to supply all PHCs with the necessary medical equipment.

Economic Hardship and Out-of-Pocket Costs

Health and economic status are positively associated: improved health outcomes correlate with improved economic conditions, and improved health outcomes are strongly associated with higher economic status and productivity. This creates a cycle in which improvements in health or economic well-being reinforce one another, whereas poverty and poor health perpetuate each other, forming a negative cycle.

According to the survey findings, 18% of participants reported that financial constraints and out-of-pocket medical costs cause significant health issues. A significant percentage of the population in the study area was impoverished. Due to their limited budget, families are compelled to cover the cost of medication, diagnostic testing, travel, and hospital stays whenever a family member falls ill, particularly with serious conditions like cancer, heart disease, or an accident. Patients often have to travel to larger hospitals in places like Haldwani, Bareilly, Dehradun, Rishikesh, or even Delhi to receive better medical care, which increases travel and lodging expenses. As a result, the family must pay for food, transportation, and lost wages in addition to medical costs.

Discussion

People in Betalghat Development Block still face issues with basic healthcare facilities, even though basic healthcare is a fundamental right of every citizen. Geographical conditions, scattered settlements, and poor road connectivity still hamper access to medical facilities, especially during emergencies. Inadequate infrastructure-lack of proper water supply and proper electricity connection- lowers the service quality and efficiency. The study also reflects a very serious scenario: a shortage of healthcare personnel such as doctors, nurses, pharmacists, lab staff, and field workers, which has increased the burden on hospitals outside the block. Mostly, newborn children and pregnant women suffer due to the shortage of specialists.

Healthcare issues are multidimensional and interconnected, requiring a joint effort to strengthen infrastructure, ensure adequate human resources, improve transport connectivity, and provide financial protection for villagers. These measures need to reduce disparities and improve healthcare quality and access in the Himalayan region.

Conclusion

The report highlights the major healthcare issues facing villages in Betalghat Development Block. The results show that a severe lack of medical staff (29%), insufficient healthcare infrastructure (22%), poor access to health services (20%), financial hardship leading to out-of-pocket healthcare expenditure (18%), and maternal and child risks (11%) are major concerns. These interconnected issues restrict the accessibility, availability, and quality of healthcare services in the study area. Together, these interrelated issues restrict access to, availability of, and quality of healthcare services in the study area. The field survey also showed that, although basic physical infrastructure exists, community health centres, primary health centres, and health sub-centres still face significant shortages of vital facilities, medical supplies, and healthcare workers. High vacancy rates among specialist doctors, Medical Officers, ANMs, pharmacists, laboratory staff, and other support personnel have weakened health institutions' capacity to provide timely and comprehensive healthcare. In addition, inadequate emergency equipment, unreliable electricity and water supply, the absence of blood transfusion and anaesthesia facilities, and poor transportation connectivity compel many Patients to seek treatment in urban centres, thereby increasing treatment delays and financial burden on rural households. These findings indicate that improving healthcare in the Himalayan region requires strengthening both the physical and human resource capacity of rural health institutions. Priority should therefore be given to filling vacant healthcare positions in accordance with the Indian Public Health Standards, upgrading community health Centres, Primary Health Centres, and Health Sub-centres with essential infrastructure and life-saving equipment, improving electricity, water supply, emergency transport, and road connectivity to remote villages and expanding maternal and child healthcare services through regular outreach and awareness programmes. Reducing out-of-pocket expenditure, strengthening financial

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protection, and expanding coverage of government health insurance schemes would further improve healthcare accessibility and equity. Implementing these measures would strengthen the rural healthcare system and contribute significantly to achieving equitable, accessible, and sustainable healthcare development in the Betalghat Development Block and other Himalayan regions.

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*Article***A Geographical Analysis of Tribal Women's Participation in Agricultural and Allied Activities in Udham Singh Nagar District, Uttarakhand***Mandeep Singh^{1*}, Anita Rudola² Akshay kumar²**¹Research Scholar (Department of Geography), School of Earth Science, H.N.B. Garhwal University, BGR Campus, Pauri Garhwal, India.**²Professor, (Department of Geography), School of Earth Science, H.N.B. Garhwal University, BGR Campus, Pauri Garhwal, India.**³Research Scholar (Department of Geography), School of Earth Science, H.N.B. Garhwal University, BGR Campus, Pauri Garhwal, India.***Email: mandeepprocha@gmail.com***Abstract**

Agriculture is one of the most important activities for an area's development. A major share of India's population is engaged in agriculture. In 2011, 8.6% of the country's total population belonged to tribal communities. This paper examines tribal women's participation in agriculture and allied sectors, as well as the challenges they face, including minor (headache, fever, cold, body pain, etc.) and major illnesses. This paper attempts to analyse the secondary data gathered from various sources, such as published Papers, Articles, and government departments, and the District Census Handbook, 2011. The data were processed and analysed using statistical methods. Most tribal women contribute more to agriculture and related sectors than men. However, due to limited knowledge of modern agricultural practices and frequent exclusion from decision-making, women cannot contribute to development to their full potential. This study suggests ways to strengthen policy structures for tribal women so they can contribute optimally to agricultural development and to their villages, based on their labour and potential.

Key Words: Tribal women; Agriculture; Development; Participation; Decision-making.

Introduction

Tribal women represent nearly half of the tribal population and play a significant role in the socio-economic development of rural and tribal communities. In developing countries, their contribution to agriculture often remains unrecognised despite their extensive involvement in farming and other livelihood activities. They actively participate in various agricultural operations and household responsibilities, and they also support their families financially through wage-based employment. A large proportion of tribal women are directly associated with agricultural activities, making them important contributors to farm production and rural livelihoods. Their involvement extends beyond cultivation to several activities that strengthen household food security and income generation. The nature and extent of their agricultural responsibilities vary across regions and communities and have shifted as the rural economy, social structures, and agricultural practices have changed. Beyond agricultural work, rural women often manage household affairs and pursue diverse livelihood activities to meet their families' economic and social needs.

Tribal women actively contribute to family income through subsistence agricultural activities alongside men, except for ploughing. They share major responsibilities in farm production and household work. Their involvement in both agricultural and domestic activities often results in a greater overall workload than that of men. Tribal women's work is always more than that of their counterparts, as they work year-round, unlike men, who enjoy seasonal and periodic leisure. In tribal communities, women play a substantial and crucial role, working hard to improve family income and livelihood security (Patel et al., 2016). Tribal women face several challenges, including low wages, limited awareness of development programmes,

inadequate education, restricted decision-making opportunities, and health-related problems. Extension services need to improve awareness of government schemes for Scheduled Tribes. Tribal farm women play a vital role and contribute significantly to small and medium-sized farms (Mohanta, 2017).

The paper examines tribal women's participation in agricultural and allied activities in Udham Singh Nagar district. During the study, tribal women could not account for their contribution to the agriculture sector because of a lack of modern agricultural technology, limited decision-making, and limited knowledge of new seed varieties, fertilisers, pesticides, etc.

This study examines the demographic profile of Udham Singh Nagar district, including population characteristics, literacy, occupation, and socio-economic conditions, with special emphasis on the tribal population. It also assesses tribal women's participation in agricultural and allied activities such as crop cultivation, livestock rearing, dairy farming, and other livelihood practices. The study further explores their contribution to household income, agricultural productivity, and rural development while identifying the challenges they face in accessing resources, technology, and institutional support.

Study Area

Udham Singh Nagar district is situated in the southeastern part of Uttarakhand and forms part of the Kumaon division. The district lies in the Tarai region and is administratively organised into seven development blocks—Jaspur, Kashipur, Bajpur, Gadarpur, Rudrapur, Sitarganj, and Khatima—which together comprise 327 Gram Sabhas. Geographically, the district extends from 28°53' N to 29°23' N latitude and 78°45' E to 80°08' E longitude. It has seven tehsils, namely Bajpur, Gadarpur, Jaspur, Kashipur, Kichha, Khatima, and Sitarganj. Most of these areas have small-scale cottage industries. These are widely blended with different cultures, religions, and lifestyles. The district is well known for communal harmony and brotherhood. After Haridwar and Dehradun, it is the third most populous district of Uttarakhand as per the Census 2011. The 2011 population was 16,48,902, with 8,58,783 males and 7,90,110 females. As per Census 2011, the SC population is higher than the ST population in Udham Singh Nagar, with 2,38,264 and 1,23,037, respectively.

Literature Review

In this paper, the researcher draws on many papers and articles, mainly on women's participation in agriculture and allied sectors. Some of the papers include (Ghosh & Varerkar, 2019) in the article, "The Analysis of Women's Participation in Indian Agriculture"; the paper explains women's participation in the agriculture sector, classified based on female worker participation in the agriculture and non-agriculture sectors. In this paper, the authors analyse women's participation in the agriculture sector using the coefficient of variation and the women's participation rate. The study found that rural women mainly work in the agriculture sector, but they do not participate effectively because of men's social attitudes and limited knowledge of modern agricultural technology. In urban areas, women participate in the non-agricultural sector, creating a large gap between rural and urban women's participation in agriculture. This study suggests that the government start new plans and policies for rural women's participation in the agriculture sector (Ranjithkumar & Dimitrov, 2023). In the article, "Status of tribal women in India with the special reference to socio-economic and education conditions", the paper analyses that the social, economic, and educational status of tribal women is very low, and they face many challenges in education, income, and occupational structure. It studies many government plans and policies that affect the status of tribal women in India. Shamna (2006) measured mass media participation, extensive participation, and

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decision-making patterns. To assess farmers' knowledge of agricultural practices, a structured schedule was developed based on the recommended cultivation practices of the crops included in the local cropping sequence. The responses were assigned scores for analysis. Before the final data collection, the schedule was pre-tested in an area outside the selected sample. Singotiya (2014) and Patel et al. (2016) found that the variable 'social participation' had a negative and significant correlation with tribal women's participation in farming activities. This may be attributed to their active involvement in Self-Help Group activities. Women who devoted more time to such activities had comparatively less time available for farm-related work. For this reason, the variable had a negative correlation with participation in farming activities (Alkire et al., 2013; Anderson et al., 2021; Malapit et al., 2019, 2020). Women's participation in decisions related to agricultural production and management, the use of income from agricultural activities, and the use of agricultural inputs have also been shown to bring economic benefits, such as improved health outcomes and increased household productivity. This paper examines the demographic profiles and participation of tribal women in agricultural and allied sectors in Udham Singh Nagar district.

Research Methodology

This paper analyses secondary data collected from papers, Articles, government Departments, and the District Census Handbook, 2011. The data were processed and analysed using statistical data shown in the Tables and a study area map created with ArcGIS Software. In the paper, statistical data tables and diagrams were created using MS Excel.

Results and Discussion

The population data for the tribal community in the district are based on the District Census Handbook 2011, which shows the tehsil-wise sex ratio and decadal population growth (2001-2011) in the district in the context of rural and urban population.

Table 1 presents the sex ratio of the total, rural, and urban population at the tahsil level according to the 2011 Census. In Udham Singh Nagar district, the overall sex ratio is 920 females per 1,000 males. The rural population records a higher sex ratio (930) compared with the urban population (903). Among the tahsils, the rural sex ratio ranges from 978 females per 1,000 males in Khatima to 906 in Kichha.

Table 1: Tehsil-wise Sex Ratio in Udham Singh Nagar District 2011

S. No.	Tehsil	Total	Rural	Urban
1	Kashipur	903	912	895
2	Jaspur	911	908	918
3	Bajpur	915	923	892
4	Kichha	900	906	895
5	Gadarpur	925	929	909
6	Sitarganj	936	938	925
7	Khatima	970	978	903
Total	Udham Singh Nagar	920	930	903

Source: District Census Handbook, 2011

Table 2 indicates that, according to the 2011 Census, the decadal variation in the Scheduled Tribe population of Uttarakhand was 13.97 per cent, with a variation of 10.25 per cent in rural areas and 70.13 per cent in urban areas. In Udham Singh Nagar district, the overall

decadal variation was 11.62 per cent, while the rural and urban areas recorded 7.87 per cent and 300.56 per cent, respectively.

Table 2: Decadal change in Scheduled Tribe(ST) population 2001-2011

District	Total	2001			2011			Difference in Decadal	Decadal Change (%)
		Person	Male	Female	Person	Male	Female		
USN	Total	110220	55941	54279	123037	61758	61279	12817	11.62
USN	Rural	108808	55081	53727	117381	58843	58538	8573	7.87
USN	Urban	1412	860	552	5656	2915	2741	4244	300.56

Source: District Census Handbook 2011.

Table 3 presents the distribution of villages by the proportion of Scheduled Tribe population relative to the total village population. In the district, Scheduled Tribes constitute 11.5 per cent of the rural population. As many as 400 villages (59.35 per cent) have no recorded Scheduled Tribe population, while 90 villages (13.35 per cent) have less than 5 per cent Scheduled Tribe population. About 28 villages (4.15 per cent) have a Scheduled Tribe population of 11–20 per cent, while 29 villages (4.30 per cent) fall within the 21–30 per cent range. In 43 villages, the proportion ranges between 51–75 per cent, representing 6.38 per cent of the district's total population.

Table 3: Proportion of Scheduled Tribe (ST) Population and Total Population in Villages 2011

ST Population in Total Population	No. of Villages	Population in Percent (%)	Schedule Tribe (ST)	Total ST Population (%)
Nil	400	59.35	0	0.00
Less than 5	90	13.35	1274	1.09
5 – 10	11	1.63	1651	1.41
11 – 20	28	4.15	11211	9.35
21 – 30	29	4.30	14746	12.56
31 – 40	28	4.15	20629	17.57
41 – 50	28	4.15	21690	18.48
51 – 75	43	6.38	35354	30.12
76 and above	17	2.52	10826	9.32
USN	674	100	117387	100

Source: District Census Handbook 2011.

Table 4 shows the distribution of villages by literacy-rate ranges for the Scheduled Tribe population, as recorded in the 2011 Census. The Scheduled Tribe population is reported in 274 villages in the district, of which 26 have a literacy rate of 100 per cent. The largest share, accounting for 56.77 per cent (66,633 persons), is concentrated in 104 villages where the literacy rate ranges between 71 and 80 per cent.

Table 4: Distribution of villages by literacy rate range for Scheduled Tribe Population (Rural)

Range of Literacy Rate in Villages	No. of Inhabited villages	Distribution of Villages in (%)	Schedule Tribe (ST)	Distribution of Population in (%)
0	12	4.38	22	0.02
1 -10	0	0.00	0	0.00
11 – 20	2	0.73	31	0.03
21 -30	2	0.73	21	0.02
31 -40	4	1.46	37	0.03

41 -50	9	3.28	353	0.30
51 -60	21	7.66	6276	5.35
61 -70	55	20.07	30050	25.60
71 -80	104	37.96	66855	56.96
81 -90	32	11.68	13101	11.56
91 -99	7	2.55	254	0.22
100	26	9.49	381	0.32
USN	274	100	117381	100
Literacy Rate	73.38			

Source: District Census Handbook 2011

Participation of Tribal women in Economic activities

In the district, tribal women participate in agricultural and allied activities such as cultivation, household work, and other activities. These activities mainly affect tribal women's health and their independent status in society.

Table 5 explains the Distribution of Tribal women's Participation in economic activities in Rudrapur city. The city's total population is 1,60,448; of this, 84,195 are males, and 76,253 are females. In the city, people are engaged in cultivation (8,606), agriculture (17,291), household activities (2,182), and other activities (27,695). Out of the total male population, cultivators (7,377), agriculture (12,941), household activities (1,120) and other activities (21,829); and out of the total female population, cultivators (1,229), agriculture (4,350), household activities (1,062) and other activities (5,866). A considerable number of Tribal women participated in agricultural activities (34.78%), but few engaged in household activities (8.49%).

Table 5: Distribution of Tribal women Participation in Economic Activities

	Total Population	Cultivators	Agriculture	Household Activities	Other Activities
Total	1,60,448	8,606 (15.43)	17,291 (31)	2,182 (3.91)	27,695 (49.66)
Male	84,195	7,377 (17.51)	12,941 (29.91)	1,120 (2.59)	21,829 (50.45)
Female	76,253	1,229 (9.83)	4,350 (34.78)	1,062 (8.49)	5,866 (46.91)

Source: District Census Handbook 2011

Conclusion

The study found that the tribal women in the district participated in agriculture and allied sectors more than men. However, because they lacked knowledge of modern agricultural practices and were excluded from decision-making, women could not contribute to agricultural development to their full potential. Tribal women participate in the agriculture sector more than in other activities/sectors. This study also found that, because of limited awareness of modern agricultural technology, tribal women could not reach their full potential in agricultural production. Therefore, tribal women need to be made aware of modern agricultural technology and equipment.

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*Research Communication***Natural and Cultural Significance of the Himalaya**

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Him + Alaya means ‘the abode of snow’; the Himalaya derives its name from Sanskrit. A unique natural formation on Earth, the Himalaya is the tallest and the youngest folded mountain system. It extends in an arc of about 2,400 km from the Pamir Knot in the northwest to the Arakan Yoma mountains in the southeast, covering the Western, Central, Eastern, and Trans-Himalaya, along with the Karakoram, Pir Panjal, and Zaskar mountain ranges that run parallel to it (Sati, 2026).

The Himalaya formed through destructive plate convergence, with the Tethys Geosyncline lying between the colliding plates. Its formation involved stages of collision, compression, faulting, and folding; therefore, the Himalaya is geologically sensitive, tectonically and seismically active, with valleys deepening and mountain peaks uplifting. As a result, the Himalaya is highly prone to catastrophic earthquakes. The Himalaya covers about 595,000 km², representing 0.4% of the world’s land area. It is home to about 55 million people, or about 0.7% of the world’s population. It spans five countries: India, Tibet, Pakistan, Nepal, and Bhutan (Fig. 1).

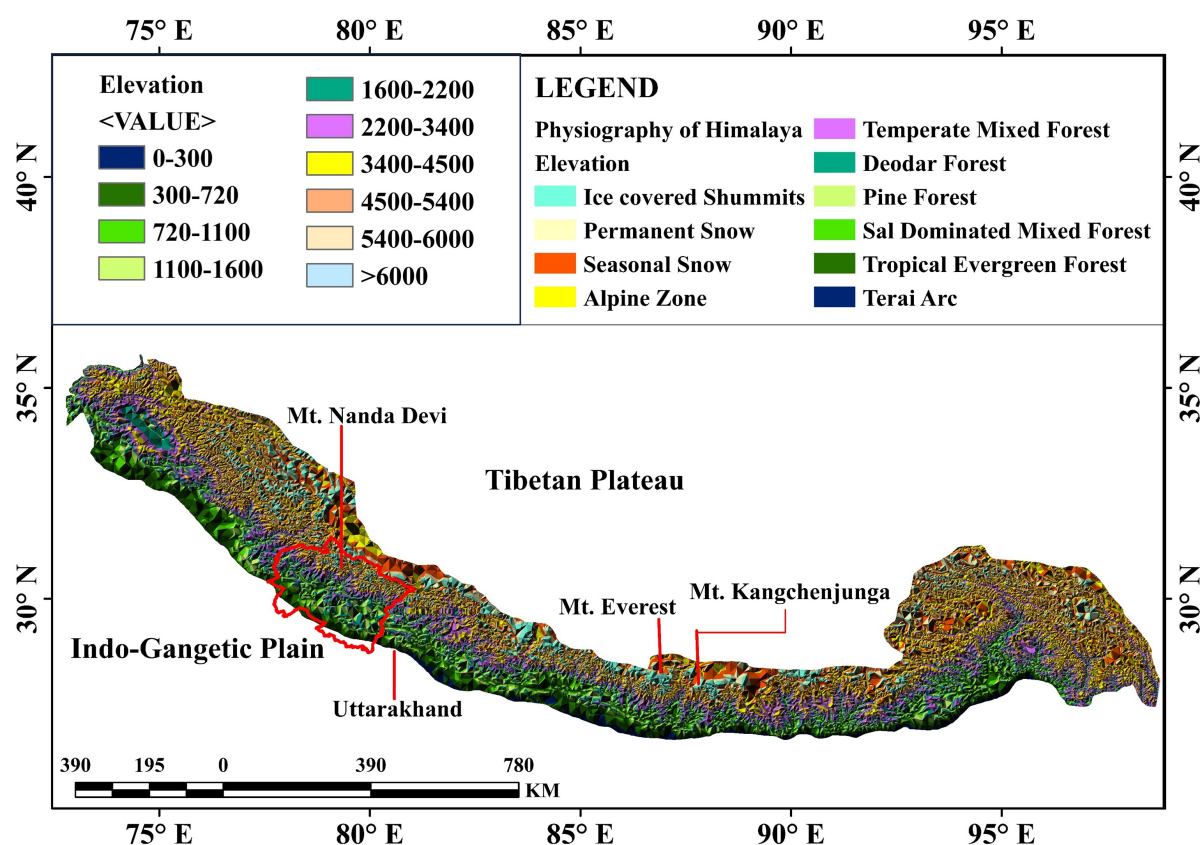


Fig. 1. The Himalayan region

Known as the ‘Water Tower of Asia’ and the ‘Third Pole,’ the Himalaya plays a crucial role in regulating climate, acting as a natural barrier, and protecting neighbouring regions. It has immense water potential – over 500 BCM annually – supported by around 17,000 glaciers

that serve as vital freshwater reserves. The Himalaya supports the livelihoods of over 600 million people across India, Nepal, Bhutan, Pakistan, Tibet, and Bangladesh, as it is the source of three of the world's largest river systems – the Indus (Sindhu), the Ganga, and the Brahmaputra. With over 80 large hydropower projects, 25 under construction, and more than 300 planned, the Himalaya has around 1,000 hydropower projects (Sati, 2019).

One of the world's 12 biodiversity hotspots, the Himalaya is known for its rich and valuable agro-biodiversity. It hosts over 10,000 plant species, more than 1,000 faunal species, and 8,000–10,000 traditional crop varieties. A large proportion of the population – over 70% - depends on agriculture, livestock, and forests for their livelihoods. The river valleys of the Ganga, Yamuna, and Brahmaputra form some of the world's largest and most fertile plains, supporting millions of livelihoods.

The Himalaya is not only rich in natural resources but also holds great cultural and spiritual significance. It is regarded as the embodiment of Shiva and Shakti, and the great Hindu epics such as the Ramayana, Mahabharata, and Matsya Purana mention its importance. According to legend, Lakshmana regained consciousness after receiving the Sanjivani herb brought from the Himalaya. Lord Krishna told Arjuna that among his various forms, he is the Himalaya. It is also believed that when the Earth was submerged in water, only the Himalaya remained. Sacred sites such as Kailash-Mansarovar, high-altitude pilgrimage centres, Devalayas, Shivalayas, Shakti Peeths, and Jyotirlingas are considered the abodes of gods and goddesses. The Ganga, revered by Hindus as 'Mother,' originates in the Himalaya and sustains millions of lives; taking a holy dip in it is believed to liberate the soul from the cycle of birth and death. The Himalaya is also considered the land where the Vedas were composed and where sages and saints performed yajnas for the welfare of life on Earth (Sati, 2022).

Over the past decades, the Himalaya has been facing enormous challenges to its existence, as well as to the millions of people whose livelihoods depend on its resources. Its natural, cultural, economic, and environmental richness has been deteriorating, and its traditional culture is gradually eroding. Traditional agriculture is declining. More than 20% of the region's population has been forced to migrate to urban centres in search of better livelihoods, partly due to climate change. About 1,700 villages have become ghost villages, a large share of arable land has been abandoned, and over 10% of natural springs have dried up. More than 15% of Himalayan flora, 10–20% of fauna, and over 1,000 traditional crop landraces are under threat. Nearly two billion people who depend on Himalayan rivers are likely to be affected by water scarcity. Due to climate-induced hazards – such as debris flows, flash floods, landslides, and mass movements – over 650 hydropower projects (about one in every four) are under threat. Of the approximately 17,000 glaciers, nearly one-third are already at risk. Natural disasters are increasing; the Central Himalaya experienced over 200 major natural disasters between 2000 and 2022. Unplanned and irrational infrastructure development has further intensified the frequency and severity of disasters in the Himalayan region (Sati, 2026).

This article emphasises that celebrating Himalaya Day should not be limited to just one day, but should be observed throughout the year. Encouraging environmental protection, cultural preservation, and regional cooperation is essential to safeguard the Himalaya's vital ecosystem for future generations. Himalayan communities' traditional livelihoods, including agriculture and livestock farming, need to be adapted sustainably to build resilience to environmental and socio-economic challenges.

Methods can be developed to build resilience against the harsh conditions the Himalaya faces, such as earthquakes, landslides, climate change, declining agriculture, and glacier melt. People in India, Nepal, and Bhutan already practice sustainable methods like terrace farming and forest conservation, and these need further strengthening. The region's rich biodiversity, including species such as the snow leopard, reflects its ecological strength. Cultural traditions

and community cooperation further strengthen resilience, helping the region cope with change and maintain balance sustainably.

Technological interventions and vulnerability analysis in infrastructure projects such as roads and hydropower, along with suitability analysis for selecting crops under climate change, will make this day more meaningful.

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Book Review**Exploring the Mystical Himalaya: Cultures, Economies, and Environment. Cham: Springer Nature. 185 pp. ISBN: 978-3-032-14275-7.**

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The Himalaya has always been the focal point of mountain research. It attracts scholars from multiple disciplines, including geography, geology, and environmental science. The Himalayan regions are ecologically fragile, geologically sensitive, culturally diverse, and have complex socio-ecological systems (Sati, 2019). These complex socio-ecological systems in the Himalaya demand a scientific approach that examines interrelationships among environment, culture, and society. Within this context, V. P. Sati's book "*Exploring the Mystical Himalaya: Cultures, Economies, and Environment*" offers a rich overview of the entire Himalayan arc. It covers the whole Himalayan region from Uttarakhand and Ladakh in India to Nepal, Bhutan, and the Tibet Autonomous Region in China. The book presents the Himalaya not merely as a physical entity but as a spiritual and dynamic socio-ecological system shaped by centuries of interaction between nature and human societies.

The book's strength lies in its broad geographical coverage. It integrates the Himalaya's environmental and economic aspects with cultural narratives and the author's empirical observations. The detailed description of the Uttarakhand Himalaya, particularly the regions such as Jaunsar-Bawar, Kedarkhand, and Manaskhand, demonstrates the author's vast empirical knowledge of the Indian Central Himalaya. The Uttarakhand sections of the book provide rich insights into its geography, culture, society, customs, and rituals of Garhwali, Kumaoni, and the people of Jaunsar-Bawar. Similarly, the discussions on "*Ladakh: The Land of Lamas*" effectively highlight the life of high-altitude people. It illustrates Ladakhi culture, livelihoods, customs, and rituals.

Moving beyond India, the book includes chapters on Nepal, Bhutan, and China. In the Nepal section, the author discusses Nepal's mountainous landscape and its rich religious and cultural heritage. The author describes Pashupatinath and Muktinath in detail, emphasising their deep spiritual significance in the region. The chapter also discusses Nepal's economy and the country's various challenges. In the Bhutan chapter, the author describes its unique development philosophy of Gross National Happiness. Bhutan is described as a Buddhist kingdom where environmental conservation and cultural preservation are central to national policy. The author also briefly discusses Tibet (China), highlighting its geographical position within the Trans-Himalayan region. The Tibetan Plateau is described as a cold, largely arid environment where pastoralism and livestock rearing remain important livelihoods. The author also discusses its cultural and religious traditions. Finally, the author discusses the Himalaya's ecological fragility and emphasises the importance of sustainable development in the region.

The book's valuable contribution lies in its spiritual descriptions of mountains, rivers, and forests. Moreover, the book's travelogue approach makes it interesting and distinctive, as it is the first of its kind in Himalayan scholarship. The book's strengths lie in its attempt to present the entire Himalayan region as a connected and diverse socio-ecological system. By examining multiple countries of the Himalayan region and cultural landscapes, the author demonstrates how the Himalaya functions as a shared system that transcends political boundaries. Integrating social, cultural, environmental, and economic perspectives gives readers a deep understanding of Himalayan societies. Another notable aspect of the book is its

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portrayal of the Himalaya as a sacred, spiritual, and mystical landscape, where natural elements such as mountains, rivers, and forests are deeply embedded in local belief systems. At the same time, the book also acknowledges several challenges people in this region face. These include increasing natural hazards, economic marginalisation, environmental degradation, and pressure from over-tourism. The author suggests that sustainable development strategies must account for the ecological fragility and sensitivity of mountain environments.

Despite this valuable contribution, the book's analytical depth remains limited. The book is mainly descriptive and relies largely on the author's personal observations and travel experiences. In addition, the book does not follow a scientific methodological framework. The lack of scientific methodology raises several questions. Although this book successfully describes the socio-cultural life of different Himalayan communities, their economic conditions, socio-economic marginalisation, livelihood constraints, and environmental vulnerability, it does not critically examine the underlying drivers of these problems. As a result, the several analyses in the book remain superficial. The book draws various conclusions without sufficient data and scientific explanation. Further, compared with other scholarly works on the Himalaya, the book remains largely narrative and makes little substantial contribution to the region's theoretical understanding. Another important limitation is its uneven regional coverage. The book discusses the Indian Central Himalaya in more detail than other regions. Countries like Bhutan, Nepal, and Tibet (Autonomous Region of China) receive comparatively little attention. This regional imbalance raises questions about how representative the book's coverage of other regions is. Moreover, the book does not examine important contemporary issues such as climate change, migration dynamics, and the expansion of infrastructure and over-tourism in sufficient depth. Given their growing role in transforming mountain societies and environments, a more detailed analysis of these issues would have significantly enhanced the book's scientific relevance. Despite several limitations, this work succeeds in presenting the Himalaya as a spiritual entity in which human societies and natural systems are deeply interconnected. Its simple and descriptive writing style makes it particularly useful as an introductory text for students and general readers interested in Himalayan society and culture.

Reference

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