IJISEM
INTERNATIONAL JOURNAL OF INNOVATIONS IN SCIENCE ENGINEERING AND MANAGEMENT

OPEN ACCESS

Volume: 5

Issue: 3

Month: September

Year: 2026

ISSN: 2583-7117

Published: 11.09.2026

Citation:

Yadav Shivangi Ashok "Infrastructure Development, Environmental Justice and Tribal Communities in the Indian Himalayan Region A Community-Centred Perspective" International Journal of Innovations in Science Engineering and Management, vol. 5, no. 3, 2026, pp. 623-629.

DOI:

10.69968/ijisem.2026v5i3623-629

Infrastructure Development, Environmental Justice and Tribal Communities in the Indian Himalayan Region A Community-Centred Perspective

Yadav Shivangi Ashok[1]

[1]*Law, Haveli Institute of Legal Studies and Research, Mumbai University*

Abstract

Infrastructure development in the Indian Himalayan region has improved connectivity and energy access but has also created significant environmental and livelihood challenges for tribal communities. This study examines these impacts through an environmental justice perspective, focusing on distribution, recognition, and participation. Using secondary sources and selected case studies of hydropower, dam, and highway development, the study highlights displacement, livelihood loss, ecological degradation, and increased vulnerability to environmental hazards. It also examines the extent to which tribal rights, local knowledge, and community participation are incorporated into infrastructure-related decision-making. The study argues that sustainable Himalayan development requires greater attention to ecological protection, tribal rights, livelihood security, and meaningful community participation.

Keywords: Indian Himalayas, Infrastructure Development, Environmental Justice, Tribal Communities, Development-Induced Displacement, Community Participation

INTRODUCTION

Development-driven infrastructure expansion in fragile ecological regions presents a central dilemma for contemporary policy and academic discourse: balancing macro-economic growth with localized environmental and social justice. Across developing economies, large-scale infrastructure such as roads, tunnels, and hydroelectric dams is frequently promoted as essential for regional connectivity, energy security, and national integration. However, the physical and spatial execution of these projects often leads to severe developmental tradeoffs, disproportionately burdening local and indigenous populations whose livelihoods depend directly on immediate natural ecosystems.

This challenge is particularly pronounced in the Indian Himalayan region, an ecologically vulnerable landscape characterized by high geological sensitivity and rich biological diversity. In recent decades, the region has undergone rapid infrastructure expansion, including wide highway networks and dense clusters of hydropower installations. While these initiatives enhance regional accessibility and electricity production, they simultaneously generate significant ecological and social costs. Mountain communities specifically marginalized tribal groups face heightened risks from development-induced displacement, land loss, forest fragmentation, and increased natural hazards such as landslides and altered hydrological regimes.

Despite extensive scholarly attention to infrastructure and mountain ecology, existing literature exhibits notable conceptual and empirical limitations. First, research frequently evaluates infrastructure projects in isolation focusing predominantly on single hydroelectric installations rather than capturing the cumulative, interconnected environmental pressures generated by multiple overlapping projects within the same river basins or valleys. Second, studies often bifurcation ecological assessments from social consequences, analyzing environmental damage independently of the human communities it impacts.

Third, while procedural frameworks such as the Forest Rights Act (2006), the Provisions of the Panchayats (Extension to Scheduled Areas) Act (PESA, 1996), and the Land Acquisition, Rehabilitation and Resettlement Act (2013) exist to protect tribal rights, there remains a critical gap in understanding how distributional justice, social recognition, and meaningful local participation interact in practice. Furthermore, broad community assessments often overlook differentiated impacts within marginalized groups, particularly the heightened vulnerabilities experienced by tribal women.

LITERATURE REVIEW

Environmental Justice and Development-Induced Displacement

The environmental justice literature provides an important framework for understanding the unequal distribution of the benefits and costs of development. Schlosberg (2004) argues that environmental justice extends beyond distributive concerns to include recognition and participation, while Schlosberg (2007) further emphasises the importance of capabilities and social well-being. These dimensions are particularly relevant to infrastructure projects affecting marginalised communities, where economic benefits may be widely distributed while environmental and livelihood costs remain concentrated locally.

Development-induced displacement literature similarly demonstrates that displacement involves more than the physical loss of land. Cernea (1997), through the Impoverishment Risks and Reconstruction model, identifies landlessness, joblessness, homelessness, marginalisation, food insecurity, loss of common property resources and community disarticulation as major risks associated with involuntary resettlement. Studies on India have reinforced these concerns. Negi and Azeez (2022), in an integrative review of 73 studies, identify land and livelihood loss, socio-cultural disruption, human-rights concerns and inadequate rehabilitation as major consequences of development-induced displacement among tribal communities. Sapre and Gori (2025) similarly argue that infrastructure and other development projects have disproportionately affected tribal communities and that monetary compensation alone often fails to restore livelihoods and social well-being.

Environmental impact assessment scholarship further suggests that recognition and participation remain relatively underdeveloped dimensions of environmental decision-making.

O'Faircheallaigh et al. (2021) show that distributive and procedural justice receives greater attention than recognition of marginalised communities and alternative knowledge systems. This is particularly significant for the Himalayas, where tribal communities possess long-standing cultural, economic and ecological relationships with land, forests and water resources.

Infrastructure Development and Environmental Impacts in the Himalayas

The Indian Himalayan region has experienced rapid expansion of roads, hydropower projects, tunnels and other infrastructure. While such projects can improve connectivity, electricity supply and economic opportunities, research increasingly documents their ecological and social consequences.

Hydropower development is particularly significant. Pandit and Grumbine (2012), examining existing and proposed dams in the Indian Himalaya, demonstrate that large-scale hydropower expansion can generate substantial threats to terrestrial biodiversity. Sahu et al. (2020) similarly highlight concerns regarding changes in river systems and the interaction between hydropower development, environmental change and local livelihoods.

Research from Kinnaur provides more specific evidence. Asher and Bhandari (2021) found that 90% of forest land diverted to non-forest activities in their study region between 1980 and 2014 was associated with hydroelectric projects and transmission infrastructure. They also identify concerns relating to forest fragmentation, biodiversity loss and the effectiveness of compensatory afforestation. Negi and Azeez's study of the Jangi–Thopan–Powari hydropower project further demonstrates that local resistance emerged from concerns regarding land, forests, water resources, livelihoods and inadequate participation. These findings suggest that community opposition should not necessarily be interpreted as opposition to development itself, but may represent demands for greater recognition and participation.

The environmental consequences of infrastructure extend beyond hydropower. Saha and Bera (2025), examining the Char Dham National Highway, find evidence linking road expansion with increased landslide frequency and magnitude in the Garhwal Himalayas. This highlights the importance of considering the geological and ecological characteristics of mountain environments when planning infrastructure.

The cumulative nature of these impacts is particularly important. Individual projects may appear manageable when assessed separately, but multiple roads, tunnels, hydropower projects and transmission lines within the same valley or river basin can generate interconnected environmental pressures. Recent research on hydropower and riverine biodiversity similarly emphasises the cumulative consequences of dams for river connectivity, sediment regimes and ecosystems.

Tribal Rights, Participation and the Research Gap

The social consequences of Himalayan infrastructure development are closely connected to the recognition of tribal rights and participation. The Forest Rights Act, 2006 recognises individual and community forest rights, while PESA, 1996 provides an institutional basis for strengthening Gram Sabha participation in Scheduled Areas. The Land Acquisition, Rehabilitation and Resettlement Act, 2013 also emphasises compensation, rehabilitation and resettlement rather than acquisition alone.

However, the effectiveness of these institutional mechanisms depends substantially on implementation and meaningful participation. Mey et al. (2023), examining hydropower projects in Uttarakhand, demonstrate the importance of public participation and local perceptions in project planning. The experience of the Tehri Dam also illustrates the difficulties involved in achieving effective rehabilitation and livelihood reconstruction following large-scale displacement (Sinha & Pokhriyal, 2001).

Recent research has further highlighted differentiated impacts within communities. Studies of hydropower development in the Hindu Kush Himalaya indicate that tribal women may experience particularly significant livelihood and participation-related disadvantages because of intersecting social and gender inequalities. This reinforces the need to move beyond treating affected communities as homogeneous groups.

Overall, the literature establishes that Himalayan infrastructure development involves interconnected economic, environmental, social and cultural consequences. However, three important gaps remain. First, much of the existing literature focuses on individual infrastructure types, particularly hydropower, rather than examining infrastructure development more broadly. Second, ecological impacts and social consequences are frequently analysed separately rather than through an integrated environmental justice framework. Third, relatively limited attention has been given to the interaction between distributional justice, recognition and meaningful participation in Himalayan development.

This paper addresses these gaps by integrating the literature on environmental justice, development-induced displacement, ecological vulnerability and tribal rights to develop a community-centred framework for evaluating infrastructure development in the Indian Himalayas.

RESEARCH OBJECTIVES

- To examine the environmental and livelihood impacts of infrastructure development on tribal communities in the Indian Himalayas.
- To assess the effects of infrastructure development on the rights and well-being of tribal communities.
- To examine the extent of tribal participation in infrastructure-related decision-making processes.

RESEARCH QUESTIONS

1. How does infrastructure development affect tribal communities in the Indian Himalayas?
2. How are tribal rights and vulnerabilities addressed in infrastructure development?
3. How effectively do tribal communities participate in infrastructure-related decision making?

RESEARCH METHODOLOGY

This study adopts a qualitative and exploratory research design to examine the environmental, livelihood, social, and participatory impacts of infrastructure development on tribal communities in the Indian Himalayan region. The study relies primarily on secondary sources, including peer-reviewed literature, government reports, Environmental Impact Assessment reports, policy documents, and legal frameworks related to tribal rights and land acquisition. Selected infrastructure projects are examined through a purposive case-study approach, covering hydropower, highway, and other major infrastructure developments. The collected evidence is analysed through thematic content analysis using an environmental justice framework based on three dimensions: distributional justice, recognition, and procedural justice. Particular attention is given to the differentiated vulnerabilities of tribal communities, including women, and to the extent of their participation in development-related decision-making.

CASE STUDIES AND EMPIRICAL EVIDENCE

Kinnaur: Hydropower Development and Tribal Livelihoods

Kinnaur district of Himachal Pradesh provides an important example of the environmental and livelihood consequences of rapid hydropower development in the

Indian Himalayas. The Satluj river basin has experienced the development of multiple hydropower projects, placing considerable pressure on forests, land and local natural resources. Asher and Bhandari (2021), based on government data and field research, document extensive diversion of forest land for hydropower development in Kinnaur and raise concerns regarding forest fragmentation, ecological degradation and the effectiveness of compensatory afforestation.

The social consequences of hydropower development are also evident in the Jangi–Thopan–Powari Hydroelectric Project. Negi and Azeez's study of local protests shows that opposition was closely associated with concerns over land, forests, water resources, livelihoods and the perceived lack of adequate participation in project-related decisions. Importantly, the resistance of local communities does not necessarily represent opposition to development itself; rather, it reflects concerns about how development costs and benefits are distributed and whether local communities have a meaningful role in determining the use of their natural resources.

The Kinnaur case therefore illustrates distributional and recognition dimensions of environmental justice**.** While hydropower contributes to broader energy and economic objectives, the environmental costs and livelihood risks are concentrated among communities living in the project areas. The case also demonstrates the importance of recognising the relationship between tribal communities and land, forests and water rather than treating these resources solely as inputs into infrastructure development.

Tehri: Displacement, Rehabilitation and Livelihood Loss

The Tehri Dam represents one of the most significant examples of development-induced displacement in the Indian Himalayas. The project resulted in the full or partial submergence of 125 villages and affected more than one lakh people, in addition to the relocation of a substantial urban population. Sinha and Pokhriyal (2001) examined the rehabilitation process and found substantial gaps in compensation, land availability and livelihood reconstruction.

The study reported that only a proportion of rural and urban households had received compensation or obtained possession of land at the new rehabilitation sites. Resettled households also faced difficulties relating to land ownership, access to common property resources, employment, drinking water, irrigation, health and education. The loss of geographical continuity and customary access to resources further complicated the adjustment of displaced communities to their new surroundings.

The Tehri experience highlights that displacement cannot be understood simply as the transfer of households from one location to another. The loss of land, community networks, common resources and established livelihood systems represents a broader disruption of social and economic well-being. The case therefore provides strong evidence for examining distributional justice and recognition of community rights within infrastructure-led development.

Char Dham Highway: Infrastructure Expansion and Ecological Vulnerability

The Char Dham National Highway project illustrates the environmental consequences of large-scale road expansion in a highly fragile Himalayan landscape. The project was designed to improve connectivity between major pilgrimage destinations, but recent research has raised concerns regarding its effects on slope stability and landslide occurrence. Saha and Bera (2025), using landslide identification and geological analysis along the highway corridors, found a strong association between road expansion and increased landslide frequency and magnitude in the Garhwal Himalayas.

The findings are particularly important because Himalayan roads are constructed within geologically sensitive and tectonically active terrain. Road widening and associated slope cutting can alter the stability of mountain slopes and increase exposure to landslide hazards. Thus, the environmental consequences of infrastructure are not limited to the immediate area of construction but may extend to settlements, agricultural land, transportation networks and other livelihood resources located along vulnerable slopes.

The Char Dham case consequently demonstrates that infrastructure benefits such as improved connectivity must be assessed alongside ecological risks. It strengthens the argument that environmental assessment in fragile mountain regions should consider not only the immediate footprint of individual projects but also the broader vulnerability created by infrastructure expansion.

Tribal Rights and Participation

Taken together, these cases reveal that the consequences of Himalayan infrastructure development extend beyond physical environmental change. The Kinnaur and Tehri cases demonstrate the importance of land, forests, water and common resources to local livelihoods, while the Char

Dham case illustrates the ecological risks associated with infrastructure construction in fragile terrain. Across these cases, a recurring issue is the extent to which affected communities are able to influence decisions concerning projects that directly alter their living environments.

The Kinnaur experience, in particular, demonstrates that community resistance can emerge when local populations perceive that their concerns are inadequately incorporated into development decisions. The Tehri case similarly highlights the consequences of weak rehabilitation and limited participation, with Sinha and Pokhriyal (2001) characterising the rehabilitation process as substantially non-participatory and non-transparent. These findings raise important questions regarding the practical implementation of tribal rights and participatory mechanisms in infrastructure planning.

Comparative Evidence

The three cases reveal a common pattern: the benefits of infrastructure development are generally framed at the regional or national level, whereas many environmental and livelihood costs are experienced locally.

Case	Major development	Key impact	Environmental justice dimension
Kinnaur	Hydropower	Forest loss, livelihood pressure, resource conflicts	Distribution & recognition
Tehri	Large dam	Displacement, rehabilitation and livelihood loss	Distribution & recognition
Char Dham	Highway expansion	Landslides and ecological vulnerability	Distribution & environmental risk

These cases therefore support the central argument of the study that infrastructure development in the Indian Himalayas should not be evaluated solely through its contribution to connectivity, energy production or regional economic growth. Its assessment must also consider who bears the environmental and social costs, whether tribal rights and livelihoods are recognised, and whether affected communities have meaningful opportunities to participate in development decisions.

This comparative evidence provides the basis for the next section, where the findings can be discussed explicitly through the three dimensions of the environmental justice framework: distribution, recognition, and participation.

DISCUSSION

The evidence from Kinnaur, Tehri and the Char Dham highway demonstrates that infrastructure development in the Indian Himalayas involves a complex interaction between economic development, ecological vulnerability and social justice. The findings are consistent with the broader environmental justice framework proposed by Schlosberg, which argues that justice should be understood not only in terms of the distribution of environmental benefits and risks but also through recognition and participation.

Environmental and Livelihood Impacts

The case studies show that infrastructure development can generate significant environmental pressures in fragile Himalayan ecosystems. In Kinnaur, hydropower development has been associated with deforestation, landslides, loss of agricultural land and pressure on water and forest resources. These environmental changes directly affect communities whose livelihoods depend on agriculture, forests and other natural resources. Similarly, the Char Dham highway demonstrates how large-scale road construction can increase environmental risks in geologically sensitive mountain areas.

The impacts therefore extend beyond the physical construction sites. Environmental degradation can translate into loss of livelihood security, reduced access to natural resources and increased exposure to hazards. This suggests that infrastructure projects in the Himalayas need to be assessed not only according to their economic benefits but also according to the environmental risks imposed on local communities.

Tribal Rights and Recognition

The evidence also highlights the importance of recognition justice. Tribal communities often have long-standing cultural, economic and social relationships with forests, land and water.

Consequently, the loss or diversion of these resources represents more than an economic loss. In Kinnaur, for example, local opposition to hydropower projects has been connected to concerns over forests, land, water, livelihoods and cultural relationships with nature.

This finding is particularly important because conventional development assessments may treat land and natural resources primarily as economic assets. An environmental justice perspective instead requires recognition of the social and cultural meanings attached to

these resources. The literature also indicates that recognition remains comparatively less developed in environmental impact assessment than distributional and procedural concerns.

Participation and Procedural Justice

The case studies further indicate that the existence of formal institutions does not necessarily guarantee meaningful participation. The Kinnaur case illustrates how local communities have mobilised when they perceived that their concerns and institutional rights were not adequately incorporated into project decisions.

Participation is therefore not simply a matter of informing communities after decisions have already been made. Meaningful procedural justice requires affected populations to have opportunities to express concerns, influence decisions and participate in determining development priorities**.** This is particularly important for tribal communities because infrastructure projects can fundamentally alter their land, livelihoods and social environments.

Differentiated Vulnerabilities

The impacts of infrastructure development are also not evenly distributed within communities. Evidence from the Hindu Kush Himalaya indicates that tribal women can experience particular disadvantages because of existing social and gender inequalities. Large hydropower projects can affect women's access to livelihoods, basic services and decision-making opportunities, while limited participation can further weaken their ability to influence compensation and resettlement processes.

This suggests that affected communities should not be treated as homogeneous groups. Gender, social position, livelihood dependence and access to resources can shape how different members experience infrastructure-related changes.

Overall Interpretation

Taken together, the evidence suggests that the central issue is not whether infrastructure development should occur, but how development is planned, implemented and governed**.** The three cases demonstrate that infrastructure can produce wider regional benefits while concentrating environmental and social costs among communities located near project sites.

Thus, the environmental justice perspective provides a useful framework for evaluating Himalayan infrastructure development through three interconnected questions: Who bears the costs and receives the benefits? Whose rights, knowledge and ways of life are recognised? And who participates in decisions? These dimensions are interrelated, and weakness in one can reinforce injustice in the others. This interpretation is consistent with Schlosberg's multidimensional conception of environmental justice and with later environmental impact assessment research emphasising the need to integrate distribution, recognition and representation.

Overall, the findings indicate that achieving environmentally and socially just infrastructure development in the Indian Himalayas requires moving beyond a narrow growth-oriented approach toward a framework that integrates ecological sustainability, tribal rights, livelihood protection and meaningful community participation**.**

CONCLUSION

Infrastructure development is essential for improving connectivity, energy security and economic opportunities in the Indian Himalayan region. However, the cases examined in this study show that such development can also impose significant environmental and social costs on tribal communities, including livelihood loss, displacement, ecological degradation and increased exposure to natural hazards.

The study highlights that these impacts should be understood through the three dimensions of environmental justice**:** distribution, recognition and participation. Tribal communities often bear a disproportionate share of environmental and livelihood costs, while their rights, cultural relationships with natural resources and local knowledge may receive inadequate recognition. Limited participation in project planning and decision-making further strengthens these inequalities.

Therefore, sustainable infrastructure development in the Himalayas requires a shift beyond a narrow growth-oriented approach. Greater emphasis should be placed on ecological protection, tribal rights, livelihood security and meaningful community participation to ensure that development benefits are achieved without disproportionately burdening vulnerable communities.

REFERENCES

Asher, M., & Bhandari, P. (2021). Mitigation or myth? Impacts of hydropower development and compensatory afforestation on forest ecosystems in the high Himalayas. *Land Use Policy,*

100, 105041. https://doi.org/10.1016/j.landusepol.2020.105041

Blue, G., Bronson, K., & Lajoie-O'Malley, A. (2021). Beyond distribution and participation: A scoping review to advance a comprehensive environmental justice framework for impact assessment. *Environmental Impact Assessment Review, 90*, 106607. https://doi.org/10.1016/j.eiar.2021.106607

Cernea, M. M. (1997). The risks and reconstruction model for resettling displaced populations. *World Development, 25*(10), 1569–1587. https://doi.org/10.1016/S0305-750X(97)00054-5

Government of India. (1996). *The Provisions of the Panchayats (Extension to the Scheduled Areas) Act, 1996* (Act No. 40 of 1996).

Government of India. (2006). *The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006* (Act No. 2 of 2007). Ministry of Tribal Affairs.

Government of India. (2013). *The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013* (Act No. 30 of 2013).

Javed, T., Xu, Z., Mahmoud, A. B., Fuxman, L., & Houjeir, R. (2024). Promoting social justice and women's rights: Mitigating the negative impacts of large hydropower projects on tribal women in the Hindu Kush Himalaya region. *Environmental Development, 50*, 101001. https://doi.org/10.1016/j.envdev.2024.101001

Mey, J., Guntu, R. K., Plakias, A., Silva de Almeida, I., & Schwanghart, W. (2023). More than one landslide per road kilometer–surveying and modelling mass movements along the Rishikesh-Joshimath (NH-7) highway, Uttarakhand, India. *Natural Hazards and Earth System Sciences Discussions*, *2023*, 1-25.

Negi, D. P., & Azeez, E. P. A. (2022a). Impacts of development induced displacement on the tribal communities of India: An integrative review. *Asia-Pacific Social Science Review, 22*(2), 50–62. https://doi.org/10.59588/2350-8329.1420

Negi, D. P., & Azeez, E. P. A. (2022b). 'No means no': People's protest against hydroelectric development in Kinnaur, Himachal Pradesh, India. *Contemporary Voice of Dalit, 17*(1), 109–

116. https://doi.org/10.1177/2455328X211069481

Pandit, M. K., & Grumbine, R. E. (2012). Potential effects of ongoing and proposed hydropower development on terrestrial biological diversity in the Indian Himalaya. *Conservation Biology, 26*(6), 1061–1071. https://doi.org/10.1111/j.1523-1739.2012.01918.x

Saha, S., & Bera, B. (2025). Char Dham Highway construction and the surge in landslide frequency and magnitude in the Garhwal Himalayas, India. *Geotechnical and Geological Engineering, 43*(6), 266. https://doi.org/10.1007/s10706-025-03233-9

Sahu, N., Sayama, T., Saini, A., Panda, A., & Takara, K. (2020). Understanding the hydropower and potential climate change impact on the Himalayan river regimes A study of local perceptions and responses from Himachal Pradesh, India. *Water, 12*(10), 2739. https://doi.org/10.3390/w12102739

Sapre, A. A., & Gori, S. (2025). Development-induced displacement in India and the tribal rights: A quest for social justice. *Journal of Asian and African Studies, 60*(1), 265–275. https://doi.org/10.1177/00219096231168064

Schlosberg, D. (2004). Reconceiving environmental justice: Global movements and political theories. *Environmental Politics, 13*(3), 517–540. https://doi.org/10.1080/0964401042000229025

Schlosberg, D. (2007). *Defining environmental justice: Theories, movements, and nature*. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199286294.001.0001

Sinha, B. K., & Pokhriyal, H. C. (2001). Rehabilitation in Tehri Dam: An evaluation. *Social Change, 31*(1–2), 110–143. https://doi.org/10.1177/004908570103100210