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Impact of Modernisation on Local Ecology: A Case Study of Upper Subansiri District, Arunachal Pradesh

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Abstract

Modernisation has increasingly shaped development trajectories in ecologically sensitive regions of India, particularly in the hill districts of the North-East. Upper Subansiri District of Arunachal Pradesh represents a fragile socio-ecological landscape where infrastructure expansion and changing livelihood patterns have intensified interactions between development and the natural environment. This study examines the impact of modernisation on local ecology through a primary survey-based analysis, focusing on community perceptions of environmental change. The research is based on data collected through structured questionnaires comprising both closed-ended and open-ended questions. The study explores key ecological dimensions, including forest degradation, changes in water resources, wildlife disturbance, landslides, and the transformation of traditional ecological practices. Findings indicate that a majority of respondents perceive significant environmental changes linked to modernisation, particularly due to road construction, village expansion, and increased use of non-biodegradable materials. Forest loss and fragmentation have contributed to declining availability of forest-based resources, while drying of natural springs and pollution of small streams have intensified water insecurity. Increased soil erosion and landslides during the monsoon further reflect ecological instability in the region. The study also reveals a shift in community dependence on forests, driven not by ecological recovery but by reduced access and changing consumption patterns. Respondents expressed concerns regarding the environmental sustainability of current development models and emphasized the need for community-based forest management, planned construction, and stricter environmental regulation. Overall, the findings highlight the cumulative and interconnected nature of ecological impacts resulting from modernisation and underscore the importance of integrating local knowledge and participatory approaches into development planning in ecologically fragile regions.

Introduction

Modernisation has become a defining feature of development processes across India, bringing significant changes to infrastructure, livelihoods, and social organization. While such transformations are often associated with economic growth and improved access to services, their ecological implications remain a matter of serious concern, particularly in environmentally fragile and culturally diverse regions. The hill districts of Arunachal Pradesh, located in the Eastern Himalayan region, represent such sensitive landscapes where

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development interventions interact closely with complex ecological systems. Upper Subansiri District is characterized by dense forests, rugged terrain, rich biodiversity, and indigenous tribal communities whose livelihoods and cultural practices have historically depended on local natural resources. Traditionally, these communities practiced sustainable resource use guided by customary norms, collective decision-making, and indigenous ecological knowledge. However, the increasing pace of modernisation—marked by road construction, settlement expansion, market penetration, and changing consumption patterns—has altered long-standing relationships between society and nature. In recent years, local residents have reported noticeable environmental changes, including forest degradation, drying of natural springs, increased soil erosion, wildlife disturbance, and frequent landslides during the monsoon season. These changes have raised concerns regarding the ecological sustainability of current development models and their long-term implications for livelihoods and environmental security. Despite these challenges, development planning in the region has often prioritized physical infrastructure over ecological sensitivity and community participation. Against this backdrop, the present study examines the impact of modernisation on local ecology in Upper Subansiri District through a community-based survey approach. By documenting local perceptions and lived experiences of environmental change, the study seeks to contribute to a more nuanced understanding of development–ecology interactions and to highlight the importance of integrating ecological considerations and indigenous knowledge into sustainable development planning.

Conceptual Background: Modernisation and Ecology

Modernisation theory traditionally views development as a shift from traditional to modern social structures, emphasizing industrial growth, infrastructure, and rational planning. However, ecological scholars and political ecologists have critiqued this approach for neglecting environmental limits and local knowledge systems. In hill regions, where ecological balance is delicate, even small-scale interventions can trigger large-scale environmental consequences such as landslides, water depletion, and biodiversity loss. Upper Subansiri exemplifies this tension between development aspirations and ecological constraints. The expansion of roads and settlements, while improving connectivity, has altered land-use patterns, disrupted natural drainage systems, and increased pressure on forests. From an ecological perspective, modernisation here is not merely a socio-economic process but a spatial and environmental transformation with long-term implications. This study draws implicitly on political ecology by recognizing that ecological change is shaped by power relations, policy priorities, and development models that often marginalize indigenous voices. Understanding community perceptions thus becomes essential for assessing the true ecological cost of modernisation.

Research Methodology

The present study adopts a descriptive and analytical research design and is based on the use of both primary and secondary sources of data. Primary data were collected through a field-based survey conducted in Upper Subansiri District of Arunachal Pradesh. A total of 100 respondents were selected for the study, all of whom are residents of the district and have been witnessing environmental and climatic changes in their surroundings over a considerable period of time. The respondents were chosen to reflect local experiences and perceptions of

ecological change associated with modernisation. Primary data were gathered using a structured questionnaire consisting of both closed-ended and open-ended questions. The closed-ended questions were designed to assess general patterns of perception regarding modernisation, ecological change, forest conditions, water resources, and environmental sustainability. The open-ended questions allowed respondents to express their personal observations of environmental change and to suggest measures for balancing development and ecological protection. Secondary data were collected from books, research articles, government reports, and relevant published sources related to modernisation, ecology, and environmental change in the North-Eastern region of India. These secondary sources were used to contextualize the findings of the primary survey and to strengthen the analytical framework of the study. The data collected were analysed using percentage-based interpretation and qualitative analysis to identify dominant trends and recurring themes in community perceptions.

Findings

Forms of Modernisation and Perceived Environmental Change

Respondents identified infrastructure development—particularly road construction and village expansion—as the most visible and impactful form of modernisation in their area. These developments have altered the physical landscape, bringing once-remote areas into closer contact with markets and administrative centres. While such changes have improved mobility and access to services, they have also introduced new environmental stresses. A substantial majority of respondents reported noticeable changes in their local environment following modernisation. This perception suggests that ecological change is not abstract or distant but directly experienced in daily life. The widespread recognition of environmental alteration indicates a collective awareness of ecological decline, challenging the assumption that development benefits are universally perceived as positive.

Graph 1 :*(Community perception of environmental change due to modernisation)*

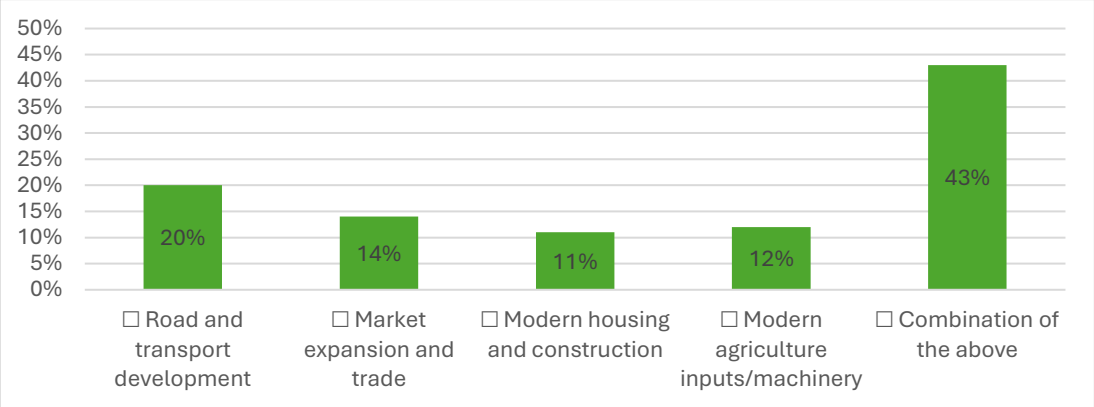


Figure 1: **Field Survey 2026**

Forest Degradation and Wildlife Disturbance

Forests occupy a central place in the ecological and cultural life of Upper Subansiri. Respondents identified loss of forest cover as one of the most significant ecological consequences of modernisation. Road cutting through forested hillsides and the expansion of

settlements have fragmented forest ecosystems, reducing both biodiversity and forest-based livelihoods. Wildlife disturbance emerged as another major concern. As forest habitats shrink and human activities intensify, wildlife encounters increase while species diversity declines. Respondents noted a reduction in forest-based resources such as wild edibles, medicinal plants, and materials used for traditional practices. This decline reflects not only environmental degradation but also the erosion of cultural practices rooted in forest ecology.

Graph 2 :*(Distribution of major ecological changes observed by respondents)*

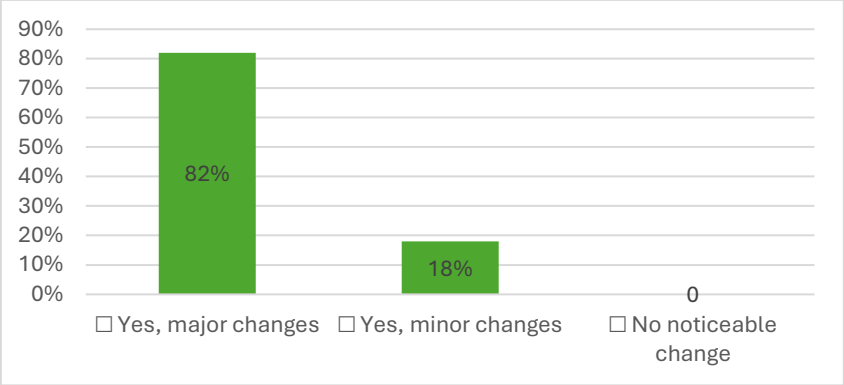


Figure 2 Field Survey 2026

Water Resources, Springs, and Ecological Stress

Water resources play a critical role in sustaining hill communities, particularly natural springs and small streams used for drinking and irrigation. Respondents reported drying of springs as a growing problem, which they associated with deforestation, hill cutting, and altered land-use patterns. The loss of perennial water sources has increased dependence on distant or unreliable alternatives, affecting household routines and agricultural productivity. The drying of water sources also reflects deeper ecological imbalance. Forests play a crucial role in groundwater recharge and moisture retention, and their degradation disrupts hydrological cycles. Thus, water scarcity in Upper Subansiri is not an isolated issue but a symptom of broader environmental stress caused by unplanned modernisation.

Graph 3 :*(Perceived changes in water sources and related ecological impacts)*

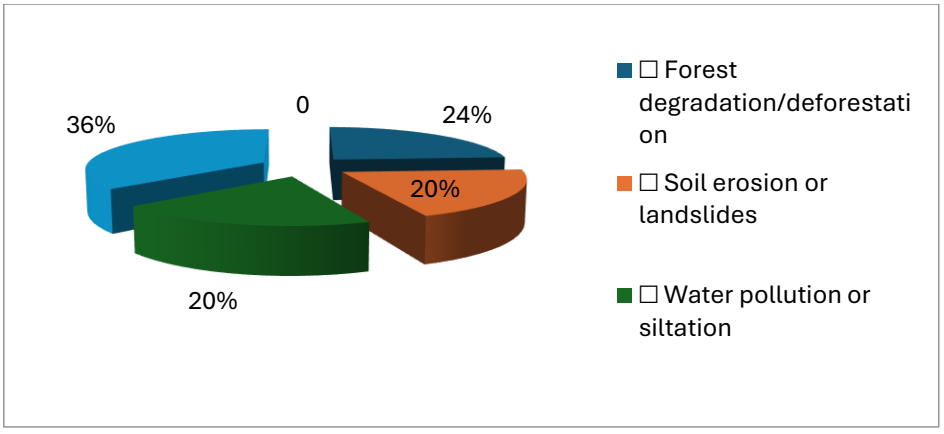
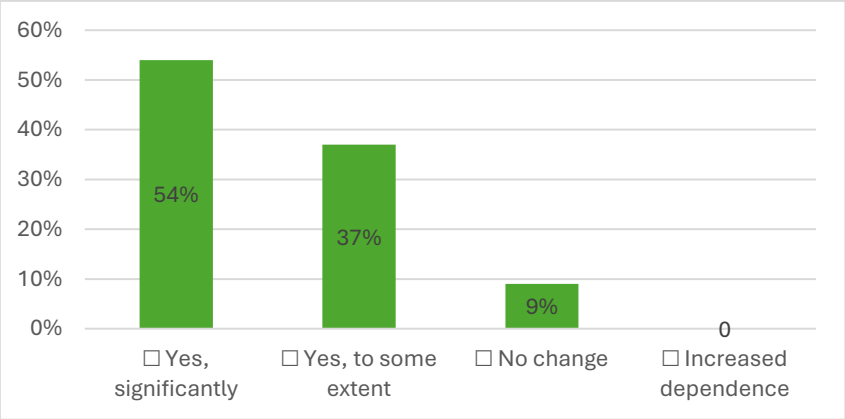


Figure 3 field Survey 2026.

Changing Dependence on Forests and Natural Resources

One of the critical dimensions of ecological change examined in this study is whether modernisation has altered the community's dependence on forests and natural resources. Traditionally, forests in Upper Subansiri District served as the backbone of subsistence, providing food, fuel, construction materials, medicinal plants, and cultural resources. The survey responses indicate that modernisation has indeed reduced direct dependence on forests, but this reduction is complex and cannot be interpreted as an environmental gain. For many respondents, declining dependence reflects reduced availability rather than voluntary withdrawal. Road construction, forest clearing, and increased regulation have limited access to forest areas, compelling households to rely on market-based alternatives such as LPG, packaged food, and commercial materials. While this shift may appear to ease pressure on forests, it simultaneously weakens traditional conservation ethics that were rooted in everyday interaction with nature. Moreover, reduced dependence has also altered social relations around resource sharing. Collective practices such as communal firewood collection and shared forest stewardship have diminished, giving way to individualized consumption patterns. This transition reflects a broader cultural shift associated with modernisation, where economic convenience replaces ecological responsibility.

Graph 8: *(Graph showing respondents' views on whether modernisation has reduced dependence on forests and natural resources)*



Changing Condition of Forests and Water Sources Over Time

Respondents were also asked to compare the present condition of forests and water sources with the past. The responses overwhelmingly suggest a perception of environmental decline. Forests that were once dense and continuous are now viewed as fragmented and degraded, while water sources that previously flowed throughout the year are increasingly seasonal or entirely dry. This perceived deterioration is closely linked to development-induced land-use changes. Forest clearing for roads, settlements, and public infrastructure has reduced canopy cover, affecting both biodiversity and hydrological stability. The loss of vegetation has compromised the natural capacity of forests to regulate water flow, leading to reduced groundwater recharge and increased surface runoff. Water sources, particularly natural springs and small streams, have suffered the most visible decline. Respondents emphasized that earlier generations relied on nearby springs for drinking and irrigation, whereas current households often travel longer distances or depend on irregular supply systems. This transformation not only increases daily labour but also heightens vulnerability during dry seasons. Importantly,

the perceived decline in forest and water conditions contributes to a sense of ecological insecurity. Communities increasingly view their environment as unpredictable and fragile, undermining confidence in long-term sustainability.

Graph 9 :*(Graph comparing perceived past and present condition of forests and water sources)*

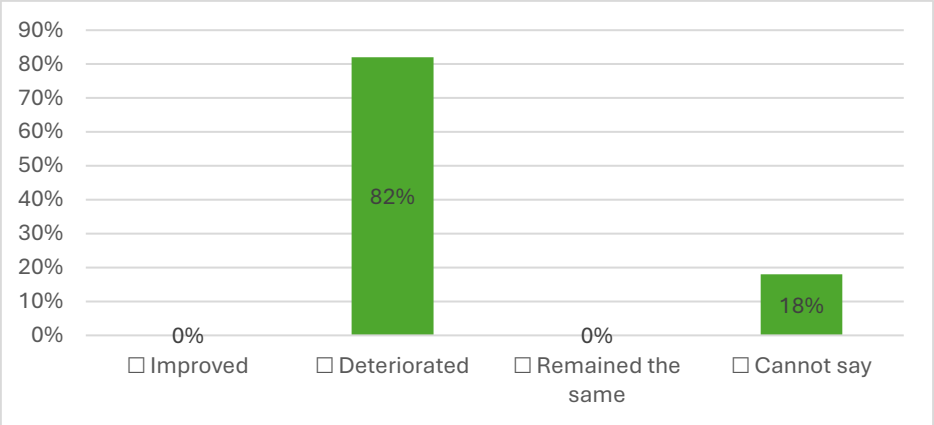


Figure 4 Field Survey 2026

Transformation of Traditional Ecological Practices

Traditional ecological practices in Upper Subansiri were shaped by collective decision-making, seasonal rhythms, and respect for natural limits. Respondents reported that modernisation has weakened these practices by promoting individual ownership, market dependence, and externally driven development priorities.Although some respondents noted reduced dependence on forests, this shift does not necessarily indicate ecological improvement. Instead, it reflects reduced access to forest resources and declining availability due to environmental degradation. The weakening of traditional ecological knowledge systems reduces community capacity to manage resources sustainably, increasing reliance on external interventions.

Graph 5: *(Impact of modernisation on traditional ecological practices)*

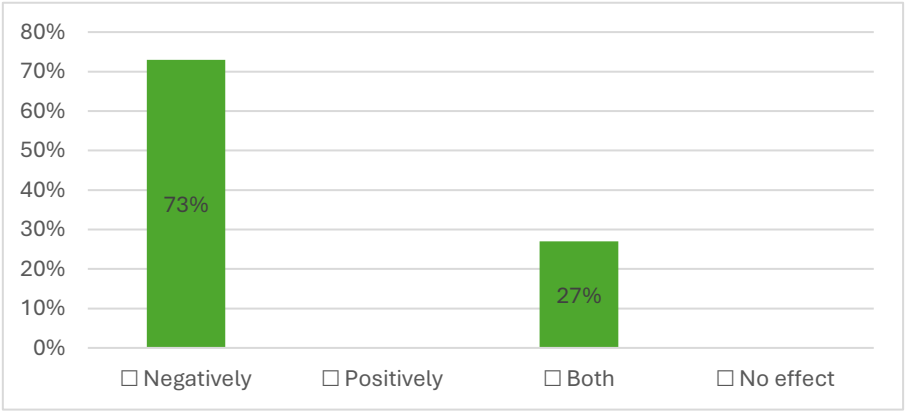


Figure 5 Field Survey 2026

Perceptions of Environmental Sustainability

When evaluating the overall sustainability of modernisation, many respondents expressed concern and dissatisfaction. While acknowledging certain developmental benefits, they questioned whether current development models adequately consider long-term ecological

consequences. This scepticism reflects a growing awareness that short-term gains may come at the cost of irreversible environmental damage.

Graph 6 :*(Assessment of environmental sustainability of modernisation)*

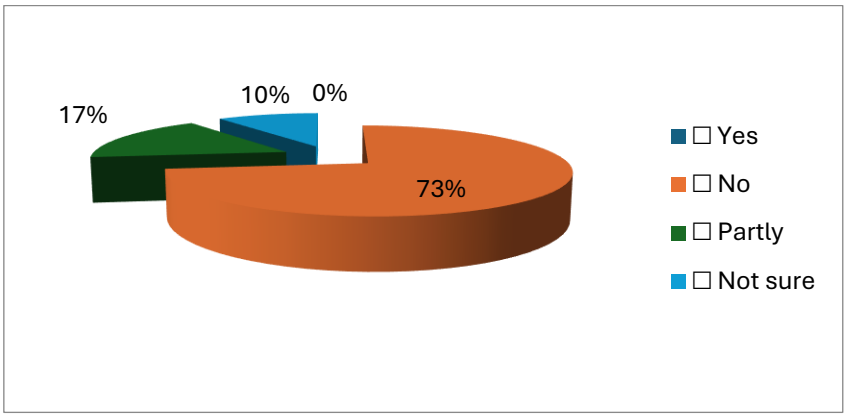


Figure 6 Field Survey 2026

Integrated Community Observations on Environmental Change

The open-ended responses provide an integrated understanding of ecological change in Upper Subansiri District by bringing together multiple environmental impacts discussed in earlier sections. Respondents most frequently pointed to forest loss resulting from road cutting and village expansion, which they associated with increased soil erosion, reduced forest resources, and heightened landslide risks during the monsoon. These observations reinforce the view that infrastructure development has directly altered the ecological stability of hill slopes. Pollution of small rivers and streams was another commonly reported concern, particularly due to construction waste and increased plastic use. Water bodies that were earlier relied upon for daily needs are now perceived as degraded, reflecting a shift in both environmental quality and waste practices. Respondents also highlighted disturbance to wildlife and declining availability of forest-based resources, indicating shrinking habitats and growing human pressure on forest ecosystems.

Additionally, the drying of natural springs and the increased occurrence of landslides were described as interconnected outcomes of deforestation and unplanned development. Together, these community observations suggest that modernisation has produced overlapping and cumulative ecological stresses rather than isolated environmental problems.

Data	Percentage
Loss of forest cover due to road cutting and expansion of villages	25%
Pollution of small rivers and streams from construction waste and plastic use	17%
Disturbance to wildlife and reduction in forest-based resources	28%
Drying of natural springs and streams used for drinking and irrigation	11%

Increase in landslides and soil erosion on hill slopes during monsoon	19%

Figure 7 field Survey 2026

Community Perspectives on Balancing Development and Ecology

Respondents strongly emphasized community-based forest protection as a key strategy for balancing development and ecological preservation. This preference highlights continued faith in collective management and local participation. Planned construction and strict enforcement of environmental laws were also identified as essential, indicating that respondents do not reject development but seek more responsible and regulated approaches.

Graph 7: *(Preferred measures for balancing modernisation and ecological protection)*

Data	**Percentage**
Planned construction avoiding landslide-prone slopes	22%
Community-based forest protection with local participation	33%
Reduction of plastic use and proper waste management	24%
Strict enforcement of environmental laws and regulations	21%

Figure 8 field Survey 2026

Discussion

The findings of this study reveal a complex and often contradictory relationship between modernisation and ecology in Upper Subansiri District. While development initiatives have improved physical connectivity and access to services, they have simultaneously intensified environmental degradation, resource scarcity, and ecological vulnerability. The dominance of forest loss, water depletion, wildlife disturbance, and landslides in community perceptions indicates that modernisation has largely unfolded without adequate ecological safeguards. A key insight from the study is the erosion of traditional ecological practices, which historically acted as informal but effective mechanisms of environmental regulation. Modernisation, rather than integrating these systems, has marginalized them, reducing community control over natural resources. This shift has weakened local resilience and increased dependence on externally driven development models. The discussion also highlights a critical mismatch between development planning and ecological realities in hill regions. Community-suggested measures—such as participatory forest management and planned construction—suggest that sustainable alternatives already exist within local knowledge systems. Ignoring these perspectives risks deepening ecological crises and undermining the very goals of development. Overall, the study underscores the need to reconceptualize modernisation in ecologically sensitive regions—not as a purely economic process, but as a socio-ecological transformation that must be guided by sustainability, local participation, and respect for environmental limits.

Conclusion

The study highlights the complex and often contradictory relationship between modernisation and local ecology in Upper Subansiri District of Arunachal Pradesh. While modernisation has contributed to improved connectivity and access to basic facilities, the findings clearly indicate that these developments have also generated significant ecological stress. Community perceptions reveal widespread concern over forest degradation, declining water resources, wildlife disturbance, increased soil erosion, and frequent landslides, all of which reflect the fragile nature of the hill ecosystem. The research demonstrates that ecological changes are not experienced as isolated events but as interconnected processes resulting from unplanned infrastructure expansion, village growth, and changing consumption patterns. The reduction in community dependence on forests, often interpreted as a sign of progress, emerges instead as a consequence of reduced access, declining availability of resources, and the weakening of traditional ecological practices. This shift has altered long-standing human–environment relationships and has reduced the effectiveness of indigenous conservation mechanisms. Furthermore, the study reveals a growing scepticism among local communities regarding the environmental sustainability of current development models. Respondents emphasized the need for community-based forest protection, planned construction that considers ecological sensitivity, improved waste management, and stricter enforcement of environmental regulations. These suggestions indicate that local communities are not opposed to development but seek approaches that are environmentally responsible and socially inclusive. Overall, the study underscores the importance of integrating ecological considerations and local knowledge into development planning in ecologically sensitive regions. Sustainable development in Upper Subansiri requires a balanced approach that harmonizes modern infrastructure needs with environmental protection, ensuring long-term ecological stability and the well-being of indigenous communities.

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