

# Migration and its impact on agriculture “A case study of Nainital district’s Bhabhar region”

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## Abstract:

This research investigates the connection between rural out-migration and changes in land use and land cover (LULC) in the Kaladhungi–Bealparao area of Nainital district, Uttarakhand. Employing a mixed-methods strategy, it combines multi-temporal Landsat images (2011–12 and 2021–22), GIS-based supervised classification, and data from 60 households. The findings indicate a reduction in agricultural land, with net sown area decreasing by 10.5% and fallow land rising by 67%. The movement of the working-age demographic has resulted in labor deficits, decreased productivity, and the neglect of less productive farmland. Concurrently, a transition towards market-focused and orchard-centered farming is noted. The results also show that migration intertwines with tourism, industrial growth, and increasing land prices, speeding up land use transformation. The research highlights the necessity of cohesive policies to advance sustainable farming, oversee land resources, and tackle rural changes driven by migration.

**Key Words:** land use and land cover change, Fragmented landholdings, land Rejuvenation.

## INTRODUCTION

Land use and land cover (LULC) alteration signifies an important aspect of human-environment interaction, especially in ecologically sensitive and socio-economically active areas like the Himalayan foothills. These landscapes are very vulnerable to human pressures and environmental changes, rendering them crucial for studying the interactions among demographic dynamics, economic shifts, and ecological transformations. Over recent decades, the Indian Himalayan region has undergone notable changes in land use patterns, influenced by alterations in livelihood strategies, market integration, and evolving socio-economic aspirations.

One of the main influences of these transformations, rural out-migration has become a significant characteristic of agrarian change. The extensive migration of working-age individuals from rural regions to cities in pursuit of better job prospects, education, and quality of life has significantly affected agricultural systems. In hilly areas like Uttarakhand, where agriculture is typically labor-driven and marked by small, fragmented holdings, migration has resulted in labor scarcities, reduced agricultural output, and the neglect of marginal lands. This method has led to the increase of uncultivated land and the slow decline of conventional agricultural techniques, altering both the rural economy and the cultural environment.

Nevertheless, migration does not function independently. Current changes in land use within the Himalayan foothills are increasingly shaped by a wider range of structural factors, such as the growth of tourism, urban development, infrastructure enhancement, and increasing land prices. The increasing impact of close attractions like Jim Corbett National Park has heightened the transformation of land for

commercial and hospitality uses, resulting in the commercialization of farmland. These processes frequently interact with migration in intricate manners—although migration decreases the labor supply for agriculture, increasing land prices and alternate income options further encourage land abandonment or transformation to non-agricultural purposes. Current research has thoroughly recorded both agrarian transformations caused by migration and land use/land cover changes in mountainous areas. Nonetheless, numerous studies often view these processes in isolation, with minimal integration of spatial and socio-economic evaluations. There is still a requirement for interdisciplinary methods that integrate geospatial techniques with field evidence to accurately represent the multi-faceted nature of rural transformation. This integration is especially crucial for comprehending how decisions made at the local level are influenced by wider regional and global dynamics.

### STUDY REGION

The Kaladhungi- Bealparao region lies in Nainital district of Uttarakhand state Kaladhungi at Coordinates 29° 17' 0.636" N & 79° 21' 3.6" E. It is well situated in the catchment area of river Koshi. The Kosi River, a significant geographical feature, forms a natural boundary between Nainital and Almora districts before merging with the Ramganga River flows through this region, and the region is well irrigated by these rivers. The region is rich in agriculture and orchards.

### OBJECTIVES

The following objectives are sufficient to understand the cause and changes in land use pattern due to migration in the study area.

- To study land use Management of the study area.
- Agricultural development and it's challenges due to migration.

### LITERATURE REVIEW

Changes in land use and land cover (LULC) have been extensively examined as a significant measure of human-environment interaction, especially in mountainous ecosystems. Eric F. Lambin (2003) underscored the influence of socio-economic factors in determining land changes, whereas M. Negi (2017) pointed out the susceptibility of Himalayan areas to human and climate-related stresses.

Migration has become a significant factor in agricultural transformation in the hill areas of India, causing labor shortages, land abandonment, and reduced agricultural output. Research in Uttarakhand has recorded the emergence of "ghost villages" and uncultivated land as a result of out-migration. Research shows that land use changes are also affected by market integration, growth in tourism, and infrastructure improvements.

Nonetheless, current research frequently analyzes migration and land use changes independently. A gap persists in comprehensive analyses that merge geospatial methods with field-derived socio-economic data to comprehend their connections. This research seeks to fill this gap by connecting migration trends with spatial changes in land use.

### RESEARCH METHODOLOGY

#### *Data Sources*

##### *a. Remote Sensing Data*

Multi-temporal satellite images were utilized to examine LULC transformations for two periods: 2011–12 and 2021–22. The collections of data comprise:

Landsat 5 Thematic Mapper (2011–2012), Landsat 8 OLI/TIRS (2021–2022)

RESOURCESAT-2 images (employed for cross-validation and enhanced classification precision) All satellite data were sourced from open-access databases like USGS Earth Explorer and NRSC portals.

*b. Main Data (Field Research)*

Fieldwork took place from March to April 2026 in chosen villages of the Kaladhungi–Bealparao area. Number of samples: 60 households Sampling technique: Stratified random sampling (considering village size and closeness to urban areas)

Ethical aspects like informed consent and respondent confidentiality were rigorously upheld

**Fig. 1.1 Landsat Images of Kaladhungi region**

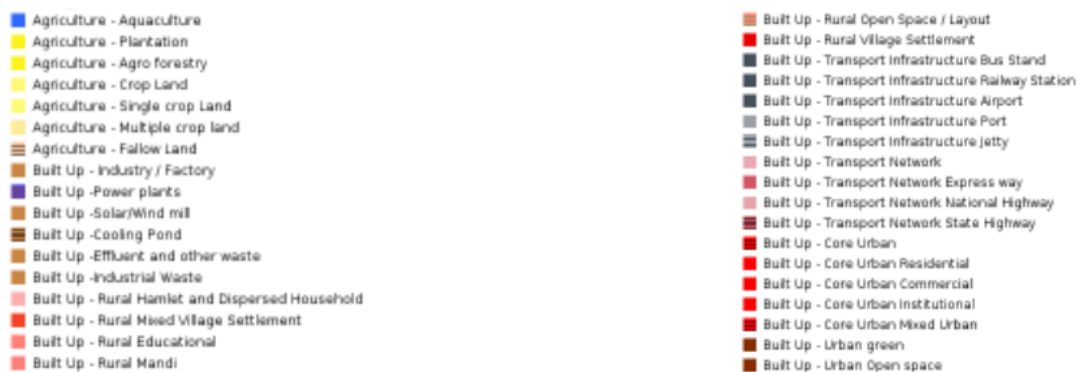
LULC Kaladhungi Bealparao region (2015-16)



LULC Kaladhungi Bealparao region (2023)



**Fig 1.2 Legend**



**Environmental & Social Feedback Loops**

In areas where farming has ceased, natural forest regrowth may stabilize slopes and reduce landslide risks. However, the increase in fallow land and the decline in active farming threaten biodiversity and weaken local food security. Many migrants rely on remittances, fostering a “money-order economy,” which contributes to the erosion of traditional agricultural knowledge and land stewardship across generations.

**Adaptive Responses**

In response to these challenges, some hill communities, such as those in Almora, have transitioned abandoned farmlands to high-value crops like medicinal and aromatic plants, supported by government initiatives. Opportunities exist to revitalize irrigation systems and equip farmers with climate-resilient techniques to enhance community resilience and agricultural sustainability in the Kaladhungi–Bealparao region.

### Migration-Related Challenges

The key issues associated with migration in the Kaladhungi–Bealparao region include:

- **A significant reduction in cultivated land**, accompanied by a rise in uncultivated and wasteland areas.
- **Labor shortages**, particularly among young men, hindering terrace maintenance and reducing productivity.
- **A shift away from traditional crops**, decreasing diversity and increasing susceptibility to economic and climatic risks.
- **Environmental consequences**, including natural vegetation regrowth and diminished agricultural stewardship.
- **Emerging adaptive strategies**, such as cultivating medicinal plants, which show potential but require customization for the Kaladhungi–Bealparao context.
- **Conversion of Fertile Agricultural Land**: Prime farmland with rich soil and access to water from rivers and canals is being leased or sold for industrial and commercial purposes. Post-conversion, the land becomes unsuitable for agriculture due to soil pollution from chemicals or construction, topsoil removal during grading, and changes in land use designation.
- **Urbanization and Infrastructure Expansion**: The growth of tourism, particularly near Jim Corbett National Park, has increased demand for hotels, resorts and many new factories and small industries (Fig. 1.3). Infrastructure developments, including roads and parking lots, encroach on farmland, reducing crop production areas and disrupting the rural agricultural landscape.
- **Disruption of Irrigation Systems**: Commercial and industrial projects divert or overexploit water sources such as canals, wells, and rivers, reducing water availability for irrigation. This directly impacts crop yields, forcing farmers to abandon traditional farming practices.
- **Rising Land Prices and Speculative Selling**: High profits from land sales for commercial ventures incentivize small and marginal farmers to sell their plots, weakening the local agricultural economy and diminishing interest in farming as a sustainable livelihood.
- **Environmental Degradation**: Industrial and hospitality developments contribute to waste disposal issues, soil and water contamination, deforestation in buffer zones, and increased human-wildlife conflict near forest boundaries, all of which undermine the natural resources critical for agriculture.
- **Small and Fragmented Landholdings** Land fragmentation, resulting in small and scattered plots, hinders efficient mechanized farming and limits crop diversification (Fig. 1.4)

Fig. 1.3



Fig. 1.4



- **Loss of Traditional Farming Practices**: The shift to non-agricultural land uses erodes traditional agricultural knowledge and practices. Younger generations are increasingly migrating to urban areas or pursuing non-agricultural jobs, further reducing farming activities.

### Dynamics of Migration and Agricultural Labor

- Field survey findings show that more than 65% of households surveyed had at least one migrant member, mainly in the age range of 18–40 years. Migration is mainly focused on nearby urban areas like Haldwani and other towns.

*Main effects consist of:*

- Severe workforce deficits during high-demand farming periods.
- Heightened reliance on aged and female workforce
- Forsaking remote or less fruitful fields
- Participants consistently associated decreasing agricultural productivity with a lack of labor and diminished investment in agriculture

### CONCLUSION

This research shows that rural out-migration has had a major impact on the dynamics of land use and land cover (LULC) in the Kaladhungi–Bealparao area of Nainital district. The noted reduction in net cultivated area, increase in uncultivated land, and alterations in cropping systems indicate a larger trend of agrarian transformation influenced by demographic shifts and changing livelihood strategies. Migration, especially among those of working age, has decreased the supply of agricultural workers, resulting in the neglect of marginal lands and a drop in conventional farming methods.

Simultaneously, the results suggest that migration by itself does not explain the changes that have been observed. The interplay of migration with tourism growth, urban development, and increasing land prices—particularly in regions affected by Jim Corbett National Park—has hastened land transformation and bolstered the transition from agriculture. These linked processes emphasize the complex characteristics of rural transformation in the Himalayan foothill areas.

The research also recognizes new adaptive strategies, such as a slow shift towards orchard-focused and high-value crop farming. Nevertheless, these adaptations continue to be inconsistent and are frequently limited by restricted access to markets, water supply, and institutional assistance. Without specific interventions, these trends could worsen spatial disparities and further undermine the agricultural foundation.

From a policy standpoint, the results highlight the necessity for cohesive and regionally tailored approaches. Enhancing agricultural sustainability can be achieved by safeguarding farmland with efficient zoning laws, encouraging climate-resilient and economically feasible crops, and upgrading rural infrastructure. Moreover, enhancing local institutions, improving market access, and establishing incentives for youth participation in agriculture are crucial to mitigate labor shortages caused by migration. Controlling tourism and industrial growth is equally crucial to avoid unplanned land transformation and environmental harm.

The Kaladhungi–Bealparao region is undergoing a significant land use transformation driven by tourism, industrial growth, and urban expansion. While these developments may yield short-term economic benefits, they threaten long-term agricultural sustainability, food security, and rural livelihoods. To mitigate these impacts, the following measures are additionally recommended:

- **Zoning Regulations:** Implement strict zoning policies to protect agricultural land from conversion to non-agricultural uses.

- **Sustainable Tourism:** Promote eco-friendly tourism practices that minimize environmental degradation and support local communities.
- **Community Awareness:** Increase public awareness of the importance of preserving agricultural land and traditional practices.
- **Land Rejuvenation:** Map abandoned terraces to identify opportunities for revitalization, focusing on high-value crops suited to the region's microclimate.
- **Labor Assessment:** Evaluate labor needs and availability to support sustainable agricultural practices.

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