Regional Disparity In Uttarakhand: A Comprehensive Disaggregated Analysis

Debjani Sarkar[1*], Dr Amar Latta[2]

[1*]Research Scholar, Department of Economics, Shri Guru Ram Rai University, Dehradun, 248001, Uttarakhand (debjanis.ddn@gmail.com)

Orchid id: https://orcid.org/0009-0009-2888-3267

[2]Assistant Professor, Department of Economics, Shri Guru Ram Rai University, Dehradun, Uttarakhand (amar.lata55@gmail.com)

***Corresponding Author:** Debjani Sarkar

*Research Scholar, Department of Economics, Shri Guru Ram Rai University, Dehradun, 248001, Uttarakhand (debjanis.ddn@gmail.com) Orchid id: https://orcid.org/0009-0009-2888-3267

Abstract

An extensive examination of the variations in socioeconomic development between the districts of Uttarakhand, India, is provided in this study report. The research uses a multi-faceted method to look at four major development indicators: agriculture, industries, healthcare, and education. The study measures the degree of regional imbalances and investigates the underlying causes of these discrepancies using secondary data sources. Factor analysis, Coefficient of Variation and k-mean clustering techniques are implemented to do the analysis. The results show that the 13 districts of Uttarakhand have remarkably different degrees of development, with a focus on the difference between the plains and the hills. The analysis reveals that the state faces substantial developmental gaps between the hill and plain regions, with the latter performing much better due to favorable infrastructure, market access, and government investments. The research highlights important issues and offers evidence-based policy suggestions meant to encourage more sustainable and equitable development throughout the whole state. This study adds to the larger conversation on balanced regional development in India by providing a comprehensive knowledge of regional differences in Uttarakhand. It also offers insightful information for development practitioners and policymakers.

Keywords: Regional disparity, Uttarakhand, socio-economic development, district-level analysis, composite development index

JEL Code: O12, I15, I25

I INTRODUCTION

Since its creation in 2000, the northern Indian state of Uttarakhand has seen substantial economic growth and development. Nonetheless, the distribution of this advancement has not been consistent across its various geographical areas. The state's distinctive geography, which is defined by a clear separation between the mountainous areas in the north and the plains in the south, has caused discernible differences in the socioeconomic development of each of its thirteen districts. The state's overall growth is seriously hampered by these regional disparities, which also have profound effects on political stability, economic sustainability, and social justice (Mamgai and Reddy 2016).

The term "regional disparity" describes the unequal distribution of social possibilities, economic activity, and living standards among various geographic locations that make up a specific territory. These discrepancies show themselves in several ways in Uttarakhand, such as variations in income levels, access to healthcare and education, infrastructural availability, and general quality of life. The continuation of these differences not only makes it more difficult for the state to attain inclusive development, but it also fuels social unrest and the exodus of people from less developed regions (Bhatt and Kausal 2021).

It is imperative that Uttarakhand's regional imbalances be addressed. For a number of reasons, balanced regional development is essential. First, it guarantees that all state citizens, regardless of where they live, share fairly in the advantages of economic expansion. Second, it aids in lowering the movement of people from rural to urban regions, which often causes urban infrastructure to become overloaded and rural areas to lose their human resource base. Thirdly, while regional disparities are widely acknowledged as a critical issue, comprehensive, disaggregated studies that offer a nuanced understanding of the problem in Uttarakhand are lacking (GOU). This is because balanced development helps to minimize feelings of neglect or marginalization among residents of less developed regions. While a number of studies have looked at state-level economic indicators, very little study has looked into the many facets of district-level growth. The lack of research in this area makes it difficult to develop focused policies and interventions that meet particular requirements in a given location (Sati 2020).

The objective of this study is to close this research gap by carrying out a comprehensive, broken-down examination of regional differences in Uttarakhand. In order to provide a complete view of the state's development landscape, this study looks at a broad variety of socioeconomic indicators in each of the state's 13 districts.

The primary objectives of this research are:

1. To quantify and map the extent of regional disparities across various socio-economic indicators in Uttarakhand's 13 districts.
2. To develop a composite development index that provides a comprehensive measure of district-level development in Uttarakhand.
3. To formulate evidence-based policy recommendations aimed at promoting more balanced and inclusive development across the state.

The study has relevance as it provide valuable insights for policy formulation and development planning in Uttarakhand. The research provides important insights that help direct resource allocation, focused intervention design, and the creation of region-specific development plans by offering a thorough, district-level examination of inequalities.

Additionally, the research's results and methodology will add to the larger body of knowledge on regional development in India and other developing nations dealing with comparable issues (Nandy 2018).

Socio Economic Profile of Uttarakhand:

Uttarakhand, a state in northern India, has shown significant socio-economic development over the years. The state's Gross State Domestic Product (GSDP) grew at a compound annual growth rate (CAGR) of 7.05% from 2011-12 to 2020-21. The per capita income of Uttarakhand was ₹2,02,839 in 2020-21, higher than the national average (DES, Gov. of Uttarakhand 2021).

Agriculture remains a crucial sector, employing around 60% of the population (Census 2011). However, the contribution of agriculture to the GSDP has been declining, with the services and industrial sectors gaining prominence. The industrial sector, particularly manufacturing, has seen substantial growth due to favourable policies and infrastructure development (Department of Industries, GOU 2022).

The literacy rate in Uttarakhand is 79.63%, with male literacy at 87.40% and female literacy at 70.01% (Ministry of Education, GOI 2021). The state has made strides in improving healthcare, with a focus on reducing infant mortality and increasing life expectancy ((National Health Mission, Uttarakhand 2022).

Tourism is a significant contributor to the economy, leveraging the state's natural beauty and cultural heritage. Despite these advancements, challenges such as migration from rural to urban areas and environmental sustainability remain. Overall, Uttarakhand's socio-economic profile reflects a blend of traditional agriculture and modern industrial growth, with ongoing efforts to balance development and sustainability (Bhhandari 2021).

II METHODOLOGY

1. Data Sources and Collection

The study is both analytical and descriptive in nature. This research makes use of secondary data sources to guarantee a thorough examination of regional differences in Uttarakhand. Secondary data was gathered from a number of official sources, such as reports from the Uttarakhand Statistical Handbook as well as District Statistical Handbooks, Census 2001 and 2011. In order to provide a more current and detailed viewpoint on district-level development indicators, additional data was added from the Directorate of Economics and Statistics.

2. Selection of Indicators

The need to include a range of development aspects that contribute to overall socioeconomic well-being served as the basis for the indicators chosen for this investigation. A total 40 indicators are taken for the study from four different sectors (Agriculture, Industries, Education and Health) that represents the major socioeconomic condition of any individual or region, taking into account the unique context of Uttarakhand as well as the body of current research on regional development (Ohlan 2013). These groups, together with the corresponding indicators, are:

Table 1: List of Indicators

Sectors	Indicators
Agriculture (AG)	Cropping intensity (Percentage)
	Irrigation intensity (Percentage)
	Percentage of gross sown area to net sown area (percentage)
	Percentage of net irrigated area to net sown area (percentage)
	Percentage of area under food grain crops to gross sown area (percentage)
	Food grain production per hectare (Quintal)
	Production of principle crops* (MT) per lakh population
	Use of fertilizer per hectare of gross sown area (Kg)
	Per capita production of principle crops* (Kg)
	Number of primary agricultural societies per hundred square km
	Number of primary agricultural societies per lakh population
	Number of Veterinary Hospitals per hundred square km
Industrial (IN)	Number of SSI units per hundred square km
	Number of SSI units per lakh population

	Number of employment generated in SSI per lakh population
	Number of MSME units per hundred square km
	Number of MSME units per lakh population
	Number of employment generated in MSME per lakh population
	Capital invested in MSME (Rs crore)
Education (ED)	Number of junior basic school per hundred square km
	Number of junior basic school per lakh of population
	Number of senior basic school per hundred square km
	Number of senior basic school per lakh of population
	Number of higher secondary school per hundred square km
	Number of higher secondary school per lakh of population
	Total enrolment status in junior basic school
	Total enrolment status in senior basic school
	Total enrolment status in higher secondary school
	Total enrolment status in higher institutions#
	Number of ST/SC student scholarship allotted
	Number of scholarship allotted for vocational education
Health (HL)	Number of hospitals per lakh of population(in '000)
	Number of hospitals per hundred square km
	Number of beds in hospitals per lakh of population
	Number of primary health centers per lakh population
	Number of primary health centers per hundred square km
	Number of medical doctors available per lakh population
	Number of para medical staff available per lakh population
	Average population per welfare[@] centers and sub-centers
	Percentage of population covered with safe drinking water supply

*principle crops = pulses and grains
includes number of degree colleges, PG colleges and universities.
@ - includes family as well as women and child welfare centers and sub-centers

3. Statistical Analysis

To analyse the regional disparities across these indicators, a range of statistical techniques were employed:

1. **Coefficient of Variation (CV):** The CV was used to measure the relative dispersion of each indicator, allowing for comparison of disparities across different dimensions (Sen 2011).
2. **Principal Component Analysis (PCA):** PCA was employed to develop a composite development index that combines multiple indicators into a single measure of overall development for each district (Filmer and Pritchett 2001).

Let's denote the component matrix as X, where X_{ij} represents the value of the j-th indicator for the i-th district. For m districts and n indicators, the matrix X is structured as:

$$X = \begin{bmatrix} X_{11} & X_{12} & \dots & X_{1n} \\ X_{21} & X_{22} & \dots & X_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ X_{m1} & X_{m2} & \dots & X_{mn} \end{bmatrix}$$

Where:

- X_{ij} is the value of the j-th indicator for the i-th district.
- m is the total number of districts.
- n is the total number of indicators.

The **Z-score standardization** (also known as Z-score normalization or standard score) transforms the values of a variable into a common scale where the mean becomes 0 and the standard deviation becomes 1. The mathematical expression for the Z-score of a value X_i is:

$$Z_i = \frac{X_i - \mu}{\sigma}$$

Where:

- Z_i is the Z-score of the i-th value.
- X_i is the original value of the i-th observation.
- μ is the mean of the dataset.
- σ is the standard deviation of the dataset.

Weighted Composite Index

a. Variance Explained by Principal Components:

Let the total variance in the dataset be explained by k principal components $\mathrm{PC}_1, \mathrm{PC}_2, \ldots, \mathrm{PC}_k$. The proportion of variance explained by each component is denoted as $v_1, v_2, \ldots, v_k$, where:

$$v_i = \frac{\text{Variance of PC}_i}{\text{Total Variance}} \text{ such that } \sum_{i=1}^{k} v_i = 1$$

b. Component Scores:

Each principal component PC_i has an associated component score, denoted by FAC_i, for each observation. These scores represent the projection of the original data onto the corresponding principal component.

c.Weighting of Principal Components:

The idea is to assign weights to the component scores based on the proportion of variance explained by each PC. Therefore, the weight for PC_i is directly proportional to v_i, the variance it explains.

d.

e.Formula for the Composite Index:

The Composite Index is calculated as the weighted sum of the component scores. If we use $w_i = v_i$ as the weight for each component, the Composite Index C can be expressed as:

$$C = \sum_{i=1}^{k} v_i \times \mathrm{FAC}_i$$

If negative values are present in the component scores, a constant C is added to each score to ensure positivity:

$$CI' = CI + C$$

Where C is typically the absolute value of the smallest component score plus a small margin. This approach provides a single composite index summarizing multiple variables, with weights reflecting the importance of each component in explaining the total variance. This formula provides the final composite index for each district, accounting for both the relative performance on each indicator and the weight assigned to each indicator.

3. Cluster Analysis: k-mean clustering was used to group districts with similar development profiles, helping to identify patterns of regional disparity (Everitt et. al. 2011).

The algorithm starts by randomly selecting k centroids, $\mu_1, \mu_2, \ldots, \mu_k$

For each data point x_i, assign it to the closest cluster based on the Euclidean distance between x_i and the cluster centroids μ_j. The assignment can be mathematically expressed as:

$$C_i = \arg\min_j \|x_i - \mu_j\|^2$$

Where:

- C_i is the cluster assignment for the data point x_i.
- $\|x_i - \mu_j\|^2$ is the squared Euclidean distance between x_i and centroid μ_j.
- $\arg\min_j$ denotes the index j of the closest centroid.

Once all data points are assigned to clusters, recompute the centroid μ_j of each cluster j by taking the mean of all data points assigned to cluster j:

$$\mu_j = \frac{1}{|C_j|} \sum_{x_i \in C_j} x_i$$

Where:

- μ_j is the new centroid of cluster j.
- C_j is the set of data points assigned to cluster j.
- $|C_j|$ is the number of data points in cluster j.

This process continues iteratively until the algorithm converges, providing k clusters that minimize the total variance within each cluster.

III RESULTS AND DISCUSSION

1. Overview of Regional Disparities

The analysis reveals significant disparities in socio-economic development across the districts of Uttarakhand.

Table 2: Indicator-wise inter-district Variations in Agricultural Sector

Indicators	Coefficient of Variations		
	2010-11	2015-16	2020-21
Cropping intensity	28.72	27.22	10.89
Irrigation intensity	12.09	11.67	9.64
Percentage of gross sown area to net sown area	9.71	8.70	10.02

Percentage of net irrigated area to net sown area	110.28	105.81	105.77
Percentage of area under food grain crops togross sown area	19.60	20.20	20.18
Food grain production per hectare (quintal)	36.65	46.68	46.84
Production of principle crops* (MT) per lakhpopulation	152.81	63.74	60.30
Use of fertilizer per hectare of gross sown area(kg)	166.76	194.43	165.71
Per capita production of principle crops* (kg)	56.54	55.89	69.90
Number of primary agricultural societies perhundred square km	43.73	43.74	44.83
Number of primary agricultural societies per lakhpopulation	58.05	62.44	60.28
Number of veterinary hospitals per hundredsquare km	39.38	39.14	43.58

Source: Author's own calculation

The table 2 highlights changes in the coefficient of variation (CV) for key agricultural and socioeconomic indicators between 2010-2021. A noticeable reduction in disparity is observed in cropping and irrigation intensity, as well as crop production, showing progress in equalizing these sectors. However, net irrigated area and access to veterinary services remain areas of concern, with persistently high or increasing disparities. Fertilizer usage and per capita crop production show fluctuations in variation. Overall, while many areas show improvement in reducing inequality, certain regions continue to face significant disparities, particularly in agricultural infrastructure and services.

Table 3 Indicator-wise inter-district Variations in Industrial Sector

Indicators	**Coefficient of variations**		
	2010-2011	**2015-2016**	**2020-2021**
Number of SSI units per hundred square km	152.39	139.43	135.78
Number of SSI units per lakh population	86.55	76.49	77.85
Number of employment generatedin SSI per lakh population	117.31	102.24	91.76
Number of MSME units per hundred square km	104.29	88.28	76.82
Number of MSME units per lakh population	20.92	23.66	41.01
Number of employment generated in MSME per lakh population	110.56	42.61	33.24
Capital invested in MSME (RScrore)	199.78	154.16	113.43

Source: Author's own calculation

The table 3 shows the coefficient of variation (CV) for several indicators related to small-scale industries (SSI) and micro, small, and medium enterprises (MSME) from 2010-2021. Over time, most indicators demonstrate a decreasing CV, reflecting reduced disparities in SSI and MSME distribution and employment generation. However, the CV for the number of MSME units per lakh population increased, indicating rising disparity in this area. Capital investment in MSMEs also saw a significant reduction in disparity. Overall, the data suggests improved regional equality in the distribution of units and employment, except for MSME units per population.

Table 4: Indicator-wise inter-district Variations in Education Sector

Indicators	**Coefficient of variations**		
	2010-2011	**2015-2016**	**2020-2021**
Number of junior basic school per hundred squarekm	43.88	47.46	42.28
Number of junior basic school per lakh ofpopulation	33.97	38.93	45.61
Number of senior basic school per hundred square Km	87.59	87.01	101.30
Number of senior basic school per lakh of Population	39.95	36.24	34.66
Number of higher secondary school per hundred square km	43.67	51.12	55.80
Number of higher secondary school per lakh of Population	45.30	39.63	41.62
Total enrolment status in junior basic school	77.12	79.68	104.36
Total enrolment status in senior basic school	67.82	95.03	90.22
Total enrolment status in higher secondary school	55.69	72.63	70.65
Total enrolment status in higher institutions#	108.69	92.29	94.32
Number of ST/SC student scholarship allotted	95.55	110.06	63.72

Number of scholarship allotted for vocational Education	162.24	204.05	124.82
Number of working Anganwadi per hundred square km	94.57	68.99	71.58
Student-teacher ratio	35.40	37.45	37.03

Source: Author's own calculation

The table 4 illustrates the coefficient of variations for various educational and demographic indicators from 2010 to 2021, reflecting disparities across districts. Junior and senior basic schools per population generally increased, though fluctuations were seen in school density per area. Higher secondary schools showed consistent improvement in availability. Enrolment disparities grew, especially in junior basic schools, while scholarships for ST/SC students and vocational education peaked in 2015 but declined by 2020. Anganwadi facilities decreased significantly, highlighting potential inequalities in early childhood care. Overall, the data underscores shifting patterns of access to education and support across the years.

Table 5 Indicator-wise inter-district Variations in Health Sector

Indicators	**Coefficient of Variations**		
	2010-11	**2015-16**	**2020-21**
Number of hospitals per lakh of population	40.86	46.72	42.39
Number of hospitals per hundred square km	42.00	42.03	88.66
Number of beds in hospitals per lakh of population	42.54	52.38	47.65
Number of primary health centres per lakh population	45.49	60.68	83.42
Number of medical doctors available per lakh Population	68.00	53.55	47.14
Number of para medical staff available per lakh Population	40.41	46.00	75.81
Average population per welfare@ centres and sub-Centres	164.50	63.40	77.32
Percentage of population covered with safe drinking water supply	30.70	24.00	27.37

Source: Author's own calculation

The table 5 highlights variations in healthcare-related indicators between 2010-2021. The number of hospitals per lakh of population increased from 40.86 to 46.72 in 2015-2016, but declined to 42.39 by 2020-2021. Hospital beds per lakh peaked in 2015-2016 at 52.38 but dropped to 47.65 by 2020-2021. Primary health centers and paramedical staff availability saw significant rises, while the availability of medical doctors decreased. The average population per welfare center reduced from 164.50 to 63.40, showing improvement. The percentage of the population with safe drinking water coverage declined slightly during the period, indicating persistent disparities.

2. Sector-wise Disaggregated Analysis

The Temporal Comparison of the Composite Index (CI) and district rankings in Uttarakhand for Agriculture, Industry, Education, and Health from 2010, 2015, and 2021 reveals crucial socio-economic trends. This analysis highlights disparities between hill and plain districts, offering insights into development progress and guiding policymakers toward more effective interventions across key sectors.

Table 6: Temporal Analysis of Composite Index and Ranking of districts of Uttarakhand:

Districts	Agriculture						Industries					
	2010-2011		2015-2016		2020-2021		2010-2011		2015-2016		2020-2021	
	CI	Rank	CI	Rank	CI	Rank	CI	Rank	CI	Rank	CI	Rank
Almora	235.81	2	248.76	2	173.92	6	127.72	13	140.95	10	189.49	9

Bageshwar	178.00	9	214.41	7	170.72	8	158.82	7	147.30	7	195.23	8
Chamoli	149.81	12	204.55	8	129.38	13	133.68	12	124.21	13	130.08	13
Champawat	162.09	10	200.22	9	175.15	5	169.15	4	145.53	8	225.72	4
Dehradun	192.43	8	138.71	12	187.48	4	219.39	3	203.56	4	253.35	2
Haridwar	226.54	3	114.83	13	233.24	2	351.75	1	355.70	1	351.82	1
Nainital	213.47	4	147.05	11	208.00	3	144.81	10	206.13	3	169.23	10
Pauri Garhwal	202.16	6	224.24	5	147.92	11	163.46	5	177.67	5	205.06	7
Pithoragarh	158.93	11	227.66	4	149.36	10	141.18	11	129.58	12	162.25	11
Rudraprayag	206.00	5	220.09	6	160.45	9	162.95	6	142.46	9	225.44	5
Tehri Garhwal	199.96	7	244.29	3	173.22	7	148.73	9	160.29	6	227.07	3
Udham Singh Nagar	315.21	1	320.93	1	337.37	1	300.63	2	227.69	2	211.69	6
Uttarkashi	146.04	13	187.50	10	129.41	12	149.18	8	130.59	11	140.22	12

Table 6 continued: Temporal Analysis of Composite Index and Ranking of districts of Uttarakhand:

Districts	Education						Health					
	2010-2011		2015-2016		2020-2021		2010-2011		2015-2016		2020-2021	
	CI	Rank	CI	Rank	CI	Rank	CI	Rank	CI	Rank	CI	Rank
Almora	162.94	10	159.71	6	164.27	10	269.74	1	248.59	4	261.13	3
Bageshwar	165.07	8	151.91	7	164.29	9	178.32	7	232.07	5	236.11	8
Chamoli	144.51	11	129.05	12	187.73	6	163.63	8	207.65	7	293.09	1
Champawat	191.02	5	145.55	8	188.38	5	132.75	11	180.65	10	214.68	9
Dehradun	226.84	3	204.71	4	327.46	1	159.06	10	145.75	11	149.95	11
Haridwar	313.49	2	306.90	2	289.43	3	112.03	12	136.57	12	131.98	12
Nainital	212.85	4	205.86	3	267.48	4	218.66	2	182.21	9	170.98	10
Pauri Garhwal	130.68	12	122.67	13	153.81	11	159.82	9	270.88	3	249.02	7
Pithoragarh	163.49	9	133.88	10	183.21	8	192.57	5	224.83	6	251.01	5
Rudraprayag	120.77	13	136.12	9	128.73	13	203.54	3	270.95	2	269.11	2
Tehri Garhwal	166.91	7	132.16	11	140.71	12	186.38	6	292.49	1	260.07	4
Udham Singh Nagar	351.55	1	353.79	1	326.73	2	95.54	13	119.33	13	127.47	13
Uttarkashi	182.86	6	172.21	5	187.67	7	202.24	4	203.72	8	249.23	6

Source: Author's Own Computation

Table 6 highlights the persistent regional disparities in Uttarakhand, particularly in agriculture, industry, education, and healthcare. Agriculture remains a key sector, especially in rural areas, but the coefficient of variation (CV) for cropping intensity, irrigation, and food grain production reveals uneven agricultural progress. Districts like Udham Singh Nagar and Haridwar, with fertile land, efficient irrigation, and proximity to markets, enjoy higher productivity. Conversely, hill districts such as Chamoli and Uttarkashi struggle with difficult terrain, poor irrigation, and limited market access, leading

to lower output. While the decade (2010-2021) saw some reduction in disparities in cropping and irrigation intensity, challenges remain, particularly in hill districts with underdeveloped agricultural infrastructure and limited access to veterinary services. In the industrial sector, Haridwar and Udham Singh Nagar lead in development due to strategic locations and robust transportation networks. High capital investment and concentration of MSMEs in these districts boost economic growth. In contrast, hill districts like Chamoli and Pithoragarh lag significantly in industrial growth due to geographical isolation, poor connectivity, and minimal market access, which limit investment and deepen regional inequalities. Education, a critical driver of socio-economic progress, shows substantial disparities. Dehradun and Nainital benefit from higher enrollment rates and more institutions, while Uttarkashi and Pithoragarh struggle with lower enrollment ratios and insufficient educational infrastructure. The gross enrollment ratio in higher education is notably lower in Uttarkashi compared to Dehradun, highlighting a significant educational gap between hill and plain districts. Healthcare also shows stark disparities. Haridwar and Dehradun boast better healthcare infrastructure, including higher hospital densities and more medical professionals. In contrast, Pithoragarh and Uttarkashi suffer from inadequate healthcare, poor connectivity, and alarming infant mortality rates (IMR), such as 62 per 1000 live births in Uttarkashi, compared to Haridwar's 28, contributing to the socio-economic divide across Uttarakhand.

3. Socioeconomic Clustering of Districts Based on Agriculture, Industry, Education, and Health Indicators

The K-means clustering method is a widely used statistical tool in socio-economic research to group regions or districts based on their similarities across multiple indicators (MacQueen, 1967). In this study, K-means clustering has been applied to categorize districts of Uttarakhand according to their Composite Index (CI), which reflects overall development across sectors like agriculture, industry, education, and healthcare. The Composite Index offers a holistic view of socio-economic status by aggregating multiple indicators into a single score, allowing for clearer distinctions between high, moderate, and low-performing districts (Jain, 2010). The clusters generated from this analysis help identify patterns of regional disparities, facilitating more targeted policy interventions (Kaufman and Rousseeuw, 2005). By understanding how districts are grouped, policymakers can better allocate resources and design programs aimed at reducing inequalities and promoting balanced regional development.

Table 7: K-mean clustering group based on Composite Index

Cluster	Districts	Characteristics
Agriculture		
I	US Nagar	Highest cropping intensities, highly developed irrigation infrastructure, highly developed irrigation infrastructure
II	Dehradun, Haridwar, Nainital	Moderate agricultural productivity, irrigation infrastructure, and fertilizer usage
III	Almora, Bageshwar, Chamoli, Champawat, Tehri, Pauri, Rudraprayag, Pithoragarh, Uttarkashi	Limited agricultural infrastructure, lower productivity, Smaller irrigated areas, and weaker institutional support
Industry		
I	Haridwar	Strong industrial base, well-developed infrastructure, significant irrigation and agricultural output, high fertilizer usage, and strategic advantages in terms of location and government support
II	US Nagar, Dehradun	Level of employment and industrial activity
III	Almora, Bageshwar, Chamoli, Champawat, Tehri, Pauri, Rudraprayag, Pithoragarh, Uttarkashi	Low density of industrial units, limited job creation in SSI and MSME sectors, low levels of capital investment
Education		
I	US Nagar, Haridwar	High enrolment rates across different educational levels, substantial number of Anganwadi centres, high student-teacher ratio
II	Dehradun, Nainital	High density of school, better student retention,
III	Almora, Bageshwar, Chamoli, Champawat, Tehri, Pauri, Rudraprayag, Pithoragarh, Uttarkashi	Low school density, declining enrolment, poor student-teacher ratios, and fewer higher education and vocational opportunities.
Health		
I	Champawat, Nainital, Uttarkashi	Well-established hospital networks, availability of medical personnel, sufficient number of hospital beds, complete coverage of safe drinking water supply
II	Dehradun, Haridwar, US Nagar	Overall hospital density remains moderate, The ratio of medical professionals is low, limited number of hospital beds
III	Almora, Bageshwar, Chamoli, Tehri, Pauri, Rudraprayag, Pithoragarh,	Less developed compared to other districts

Source: Author's own computation

Table 7 categorizes districts into three clusters based on their characteristics in Agriculture, Industry, Education, and Health. This clustering analysis highlights varying levels of development and regional disparities, offering insights into the region's socioeconomic structure. The clusters reveal trends and key areas for policy intervention to promote balanced development across districts.

Agriculture Cluster Analysis

Agriculture plays a crucial role in the economic stability of Uttarakhand, and districts have been grouped into three clusters based on their agricultural development. Cluster I features Udham Singh Nagar (US Nagar) as the sole district, excelling in agriculture with high percentages of irrigated land, cropping intensity, and productivity. US Nagar's advanced irrigation infrastructure supports multiple cropping seasons, while extensive fertilizer use boosts productivity. The district also leads in food grain production, positioning it as a key agricultural hub in the region. Cluster II includes Dehradun, Haridwar, and Nainital, which are moderately advanced in agriculture. These districts have lower cropping and irrigation intensities compared to US Nagar. Although their agricultural productivity is strong, it is less intensive, likely due to competing economic activities like tourism in Nainital and Dehradun or industrial growth in Haridwar. Agricultural land in these districts may also be shifting toward non-food crops or urbanization, contributing to their moderate development in agriculture. Cluster III consists of hill districts such as Almora, Bageshwar, and Chamoli, where significant challenges limit agricultural growth. Lower cropping intensity, limited irrigation infrastructure, and restricted access to modern farming techniques hinder agricultural productivity in these regions. The harsh terrain, poorer soil quality, and lack of mechanization further restrict yields, placing these districts in Cluster III. Overall, the constraints faced by these hill districts highlight their lag in agricultural development compared to more advanced regions like US Nagar.

Industry Cluster Analysis

The industrial sector is crucial for Uttarakhand's economic growth, and the analysis reveals significant disparities across districts. Haridwar stands in Cluster I as the most industrially developed district, excelling in small-scale industries (SSI) and medium, small, and micro-enterprises (MSMEs). Haridwar leads in industrial density and employment generation, thanks to its robust infrastructure, favorable policies, and strategic location near major transportation hubs. The district's capacity to attract investment and sustain industrial growth makes it an industrial powerhouse in the region. Despite minor fluctuations in capital investment, Haridwar continues to dominate in both industrial output and job creation.

In Cluster II, Udham Singh Nagar (U S Nagar) and Dehradun show moderate industrial development. U S Nagar demonstrates steady industrial growth but falls behind Haridwar in terms of industrial density and employment generation. Dehradun, with a higher concentration of small-scale industries, has stronger industrial activity compared to U S Nagar, but both districts trail in employment and capital investment when compared to Haridwar. While MSME units in U S Nagar and Dehradun continue to expand, their progress remains moderate, leaving room for further development in these regions.

Cluster III consists of districts like Almora, Bageshwar, Chamoli, and Uttarkashi, which experience minimal industrialization. These areas have a very low presence of small-scale industrial units, limited capital investment, and minimal contribution from MSMEs, resulting in fewer job opportunities and slower economic growth. The challenging geographical terrain, poor transportation, and limited market access further restrict industrial development in these districts. Consequently, these areas remain underdeveloped in terms of industrial activity, infrastructure, and investment, reflecting the significant gaps between the hill regions and more developed districts like Haridwar.

Education Cluster Analysis

U S Nagar and Haridwar rank in Cluster I for education due to their strong performance across key indicators. Both districts boast a well-developed infrastructure, with numerous junior and senior basic schools ensuring widespread access to primary education. The growing number of higher secondary schools supports student transitions to advanced learning, and high enrolment rates indicate active student participation. Additionally, the abundance of Anganwadi centres in these districts promotes early childhood education, setting a strong foundation for long-term academic success. While the student-teacher ratio in U S Nagar and Haridwar is higher than in some districts, improvements are underway, highlighting efforts to enhance education quality. These factors make U S Nagar and Haridwar leaders in Uttarakhand's education sector. Dehradun and Nainital, in Cluster II, also demonstrate strong educational development, with well-established infrastructure and consistent growth. Dehradun has expanded its senior and higher secondary schools, contributing to its status as an educational hub, while Nainital has focused on secondary education, improving student retention. Both districts have high enrolment rates, with improving teacher-student ratios ensuring more personalized attention and better learning outcomes.

In contrast, districts like Almora, Bageshwar, Chamoli, and Pauri Garhwal, grouped in Cluster III, face challenges. These districts have fewer schools, particularly in remote areas, limiting access to education. Declining enrolment rates, especially at the secondary level, reflect issues like migration and reduced school attendance. The shortage of higher education institutions and vocational training programs further hinders educational development. Additionally, high student-teacher ratios in these districts affect the quality of education, with overcrowded classrooms limiting effective teaching. These factors contribute to the lower educational development in Cluster III districts.

Health Cluster Analysis

The health sector plays a crucial role in regional development, and disparities in healthcare access and quality are evident across districts. Champawat, Nainital, and Uttarkashi are placed in Cluster I due to their advanced healthcare infrastructure. These districts have well-established hospital networks and a higher concentration of medical personnel, enabling consistent, high-quality care. Their strong healthcare systems also benefit from adequate hospital bed availability, allowing them to meet healthcare demands efficiently. Nainital stands out for its well-prepared healthcare system, further supported by a robust network of primary health centres, which improve healthcare access in rural areas. The near-complete coverage of safe drinking water in these districts also contributes to public health improvements, reducing waterborne diseases. These factors place them in the highly developed category for health.

Dehradun, Haridwar, and Udham Singh Nagar fall into Cluster II, reflecting both progress and ongoing challenges in healthcare. While these districts have a reasonable number of hospitals, their healthcare infrastructure lags behind more developed areas. The ratio of medical professionals, particularly doctors and paramedical staff, remains low, affecting both the quality and accessibility of care. Bed availability is also limited, exacerbating patient overcrowding, particularly in Haridwar and Udham Singh Nagar, where population pressures strain resources. Access to safe drinking water remains only moderately adequate, further highlighting the need for infrastructural improvements.

Almora, Bageshwar, Chamoli, Tehri, Pauri, Rudraprayag, and Pithoragarh, classified in Cluster III, face significant healthcare challenges. Limited access to hospitals and a shortage of medical professionals hinder healthcare delivery in these districts. Even in areas where hospital infrastructure has improved, the availability of doctors and paramedical staff remains insufficient. The slow growth in primary healthcare centres has not kept pace with population needs, further contributing to the underdevelopment of health services in these districts.

4. Factors Contributing to Regional Disparities

Several factors emerge as key contributors to the persistent regional disparities in Uttarakhand:

1. Topographical Challenges: The rugged terrain of hill districts poses significant obstacles to infrastructure development and economic activities, leading to higher costs and lower returns on investments .
2. Historical Development Patterns: The concentration of industrial development in the plains during the pre-statehood period has created a path dependency that continues to influence current development trajectories.
3. Migration Dynamics: Outmigration from hill districts to plains and urban areas has led to a brain drain and labor shortages in less developed regions, further exacerbating disparities .
4. Policy Implementation Gaps: Despite state-level policies aimed at balanced regional development, implementation challenges and resource constraints have limited their effectiveness in bridging the development gap.
5. Climate Vulnerability: Hill districts are more susceptible to climate-related risks such as landslides and flash floods, which disrupt economic activities and strain limited resources.

IV CONCLUSION AND POLICY RECOMMENDATIONS

The study on regional disparities in Uttarakhand highlights significant socio-economic inequalities across districts, particularly in agriculture, industry, education, and health. The analysis reveals a pronounced gap between the hill and plain regions, with the plains performing better due to better infrastructure, market access, and government investment. Districts like Udham Singh Nagar and Haridwar excel in agriculture and industrial development, while hill districts like Chamoli and Uttarkashi struggle with low agricultural productivity and limited industrial growth due to geographic isolation and poor infrastructure. Education and health services also reflect this divide, with plains districts such as Dehradun enjoying better facilities, higher enrollment rates, and superior healthcare compared to the hills, where access to schools and healthcare remains limited. The study concludes that addressing these disparities requires targeted policies, including region-specific investments, improved connectivity, and sector-focused programs to uplift the lagging hill districts, fostering more balanced and inclusive development across Uttarakhand. The research's conclusions lead to the following policy suggestions being put forth:

1. **Targeted Investments**: Direct higher per capita funding to lagging districts to address infrastructure deficits.
2. **Sector-Specific Approaches**: Customize strategies for education, healthcare, and connectivity in hill districts with local solutions.
3. **Hill-Based Economic Development**: Encourage growth in eco-tourism, organic farming, and traditional crafts unique to hill regions.
4. **Empower Local Governments**: Grant greater autonomy to local governments for tailored development efforts.
5. **Improve Connectivity**: Prioritize physical and digital infrastructure upgrades to reduce isolation and enhance economic prospects.
6. **Skill Development Programs**: Implement skill-building initiatives aligned with local needs to reduce migration.
7. **Incentives for Private Investment**: Offer tax breaks and subsidies to attract private investment to underdeveloped districts.
8. **Sustainable Tourism Policies**: Develop balanced tourism strategies that protect the environment.

The implementation of these recommendations requires a coordinated effort from state and local governments, civil society organizations, and the private sector. Regular monitoring and evaluation of development indicators at the district level will be crucial to assess the effectiveness of interventions and make necessary adjustments.

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