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The 2023 India Cluster Panorama



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Executive Summary

This research paper delves into the concept of competitiveness and clusters, drawing inspiration from the seminal work of Michael Porter and guided by the empirical research conducted by Dr. Christian Ketels across various countries. It is a joint publication of Institute for Competitiveness (IFC), Economic Advisory Council to the Prime Minister (EAC-PM), Institute for Strategy and Competitiveness, Harvard Business School (ISC) and US Asia Technology Management Center, Stanford University.

Clusters, the geographic concentrations of related economic activities connected through local linkages and spillovers, are a critical driver of locational competitiveness. Michael Porter, who developed this definition, translated earlier thinking about clusters into the context of the modern economy. Clusters thus understood are not just the small local concentrations of artisans or crafts in SMEs that they are often associated with in India. They exist in many parts of the economy, and engage the most sophisticated industries and firms, including the activities of multinationals.

A granular, evidence-based view of the cluster structure of an economy provides critical insights for policy makers. The relative lack of strong clusters erodes the overall competitiveness of an economy. And it is a symptom of weaknesses in the business environment that block the emergence of stronger clusters in response to market signals. The identification of the strongest clusters in a given industry allows national policies to target the most appropriate locations. Knowledge about the cluster portfolios for each location enables policy makers to devise location-specific growth strategies that leverage the unique circumstances they face.

The India Cluster Panorama 2023 provides unique new insights into the cluster structure of the Indian economy. It leverages powerful data from the Periodic Labour Force Survey (PLFS), which has comprehensive coverage of the Indian labour force and granular data on wages and employment in 5-digit National Industrial Classification (NIC) industries at the district level. The data is aggregated into cluster categories; these cluster categories were generated by mapping the 5-digit INC codes into Benchmark Cluster Definitions derived in the U.S. and applied in a range of other economies. The Indian cluster database provides a detailed view on the overall composition of the Indian economy, the geographic footprint of specific cluster categories across India, and the cluster portfolio of every Indian district and state. This data is used to identify India's top clusters, and India's districts and states with the strongest cluster portfolios. The PLFS provides additional information about gender, occupations, and the legal nature of the employment relationship that can be connected to clusters.

The India Cluster Panorama shows how much location matters for understanding the Indian economy. Economic activity in many key cluster categories is highly concentrated, with a few districts accounting for a large share of national value creation in these sectors. Districts differ dramatically in their economic composition and in the strengths of their cluster portfolios. The most prosperous Indian districts generate significantly more of their economic output in strong clusters, and they are specialized in different types of clusters than less prosperous districts. These results are broadly in line with the experience of other economies, with the extent of differences across locations if anything larger in India.

The India Cluster Panorama also provides new insights into some of the development challenges that the Indian economy continues to face. It confirms the still large role

new perspectives on the role of agriculture in different locations, and the significant performance differences across India in agriculture. It provides insights into the relative weaknesses of manufacturing clusters as a subsection of traded clusters, i.e., those cluster categories that compete across locations and are most profoundly concentrated geographically. But it also provides important guidance for policies like production linked incentives (PLIs) that aim to build and strengthen existing manufacturing capabilities. It also points out significant distortions in some local clusters, i.e., those present in all districts broadly in line with the overall size of the respective economy. Local clusters controlled by government have comparatively high wages, and wages that seem least responsive to local circumstances.

The India Cluster Panorama is a powerful tool for policy makers to devise policies that can help stronger clusters to emerge, and that can deploy national and state-level policies more effectively by aligning them with the specific circumstances of individual locations and the geographic footprint of specific sectors.

Introduction

In today's rapidly changing global economic landscape, nations must adopt newer perspectives to approach their economies. A key perspective is understanding competitiveness and its relationship with the productivity and prosperity of a nation. Enhancing competitiveness can strengthen an economy foundationally, making it more resilient to shocks and downturns, while increasing productivity levels in the nation. To understand a nation's competitiveness, it is necessary to adopt a microeconomic approach (bottom-up approach) and understand how firms and regions compete and attain competitiveness.

India is a country with a diverse and complex economic landscape. There is a huge heterogeneity of economic performance and specialization patterns across different regions and sectors of the country. Historically, the key focus of economic research to understand the competitiveness level was the nation as a whole. However, globalization has made regions at lower geographical levels like states, counties, and cities hubs of economic activities, driving the competitiveness of the country. In addition, every country experiences a substantial difference in economic performance across sub-national regions. This implies that a large number of the crucial factors affecting the nation's economic performance could be discovered at the regional level.

The economic map of the world is dominated by clusters, having exceptional competitive success. They are found in all types of economies like finance in Wall Street of New York, entertainment in Hollywood (Los Angeles) and Bollywood (Mumbai), consumer electronics in Japan, and Information Technology in Bangalore. Clusters is defined as a group of interconnected firms, suppliers, service providers, and associated institutions in a particular field, often linked by commonalities and complementarities, which compete as well as coordinate. They reflect and amplify competitive advantage through increasing productivity, innovation, capacity, and stimulating new business formation that supports innovation.

The India Cluster Mapping Initiative is an attempt to provide a new conceptual lens to understand clusters in India beyond traditional local artisan networks. The initiative draws on internationally established cluster mapping methodology and suggests that a cluster-based economic development approach has a much wider relevance in India. By identifying and mapping clusters across different regions and sectors, we hope to provide a better understanding of the performance and potential of different industries and regions, thereby improving their competitiveness.

Therefore, understanding the competitive advantage of regions, where clusters are located, is key to unlocking the economic potential of India. By mapping economic clusters and identifying the factors that drive their success, the India Cluster Mapping Initiative aims to promote more effective policies and strategies that can enhance the competitiveness and productivity of different regions and sectors. It also has potential to provide employment opportunities for women and promoting policies that support their participation in the labour market, we can reduce gender disparities and promote more inclusive economic growth.

The paper identifies and analyses the cluster portfolio present in the sub-national regions: states, and districts of India, and critically examining the role of clusters in enhancing the local competitiveness of the region. We seek to explore basic facts about the regional economies of India and dive deep into answering essential questions like: why and how much do regions vary in employment and productivity? Does the particular composition of clusters in a region matter for gaining high productivity and competitiveness?

Additionally, the availability of new data and robust data provides an opportunity to draw on the cluster mapping methodology to inform efforts addressing key national policy priorities such as Make in India, regional strategies, and getting women into the labour markets. The initiative aims to provide better tools and frameworks to policymakers, researchers, and practitioners to identify and promote economic clusters that can drive economic growth and development in India. Through the India Cluster Mapping Initiative, we hope to create a better understanding of the economic landscape in India and provide a new approach to economic development that is informed by the strengths and potential of different regions and sectors. Through the process of mapping economic clusters and understanding the key drivers behind their success, we can pave the way for the implementation of more effective policies and strategies. By gaining insights into the unique strengths, capabilities, and interconnections of clusters, we can develop targeted interventions that enhance the competitiveness and productivity of different regions and sectors. This approach enables us to leverage the specific advantages and opportunities offered by each cluster, fostering innovation, collaboration, and sustainable economic growth. By aligning policies with cluster dynamics, we can unlock the full potential of these economic engines and propel our economies towards greater prosperity.

Structurally, the paper is divided into four sections which breakdown the cluster-based analysis of Indian economy. First section is a detailed methodological note on the cluster mapping initiative of India. It illustrates the process of creating and mapping the definitions of Indian clusters based on the National Industrial Classification (NIC-5 digit) 2008. The U.S. Benchmark Cluster Definitions (BCD), which uses the North America Industry Classification System (NAICS) codes, is taken as the reference. Then, these definitions are used on the annual Periodic Labour Force Survey (PLFS) dataset from the year 2017-18 to 2020-21.

Section two of the paper presents the India's cluster landscape at the national level, where clusters and their composition in terms of sector, gender, type of skills and employment are discussed and compared within broad and narrow cluster categories.

In section three, focus is laid on exploring reasons why the regional economies differ significantly from each other in terms of productivity and prosperity through the lens of a cluster and its business environment, at state and district level. The economic performance of these regions is also calculated through cluster strength using the three-star methodology mentioned in the previous section.

Section four section summarises the principal facts and learnings arising from the analysis undertaken in the paper, also looking at the next steps which can be taken towards adopting a cluster-based economic development approach in the country.

The appendix contains the state and clusters profiles, along with conceptual and theoretical background of competitiveness and clusters.

The Cluster Mapping Methodology

Cluster Definitions

Cluster definitions operationalize the conceptual notion of clusters as geographic concentrations of related economic activities, connected through local linkages and spillovers, to enable quantitative analysis. The benchmark cluster definitions. Delgado (2016) used co-location of employment and establishments along with input-output relationships and similarities in skill use. It was used to develop an algorithm which assessed the quality of different sets of cluster definitions, by capturing multiple types of inter-industry linkages. The algorithm found the best possible match of industries to clusters, uniquely assigning the North America Industry Classification System (NAICS) codes to a specific cluster category. It was followed by expert assessment and few adjustments of individual clusters in the best configuration to create the final set of definitions to be used as U.S. Benchmark Cluster Definitions (BCD). This resulted in 67 different cluster categories, divided into two broad groups "Traded" (51) and "Local" (16). The former tends to be concentrated in the subset of geographical regions focusing on trade nationally and internationally, while the latter is present in almost all the regions, primary engaging in local market.

The benchmark cluster definitions can be applied to any existing data sets capturing economic activity through the industrial codes. The Indian Cluster definitions have been created by mapping the existing NAICS codes definitions to National Industrial Classification (NIC-5 digit) 2008. The mapping resulted into 68 cluster categories with 3 broad categories, namely, Traded clusters (50) , Local (17) clusters and Agriculture(1). Agriculture is considered a part of the traded cluster category in the other developed economies, as it is highly commercialized and technology intensive. However, unlike them, India is still significantly dependent on its agriculture sector as it provides employment to more than 40% of its population and contributes substantially to its exports. It has key features of both traded and local type of clusters. Consequently, Agricultural Inputs and Services were designated as a third broad category of clusters in India. Among the local clusters, new cluster category of local government was also introduced due to its unique presence and characteristics in the country.

Data:

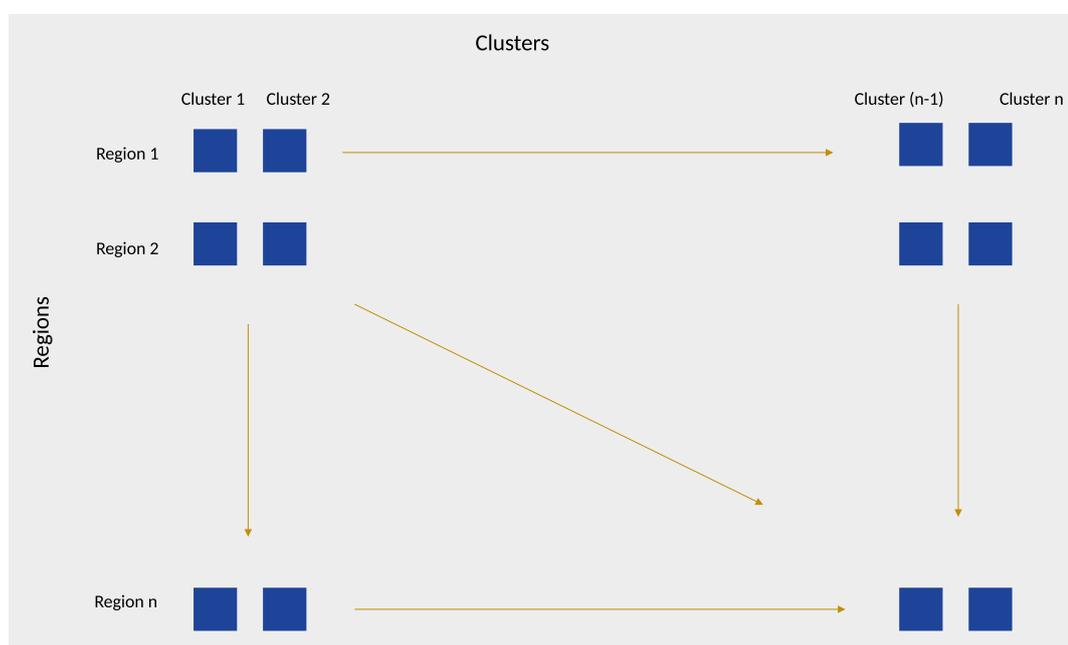
Given that National Industrial Classification (NIC) codes are present in various survey datasets such as the Annual Survey of India (ASI), Economic Census, Census, Household consumer expenditure, and others, the application of cluster definitions can be extended to these available datasets. However, it is important to note several limitations are associated with these datasets. One such limitation is the irregular availability of data, with significant gaps between consecutive surveys spanning 3-4 years. Alternatively, in cases where data is available on an annual basis, such as with ASI, the geographical coverage is limited to the state level.

The Periodic Labour Force Survey (PLFS), is one exception as the annual survey provides valuable data for analysis in all aspects. Unlike other surveys, the PLFS offers a relatively granular level of geographical coverage, focusing on districts. This level of detail enables a more localized understanding of economic activity and labour force dynamics. Furthermore, the PLFS captures data using 5-digit NIC codes, allowing for a higher level of industry-specific analysis and clustering. The availability of such comprehensive, regular and geographically specific data through the PLFS enhances the applicability and accuracy of cluster definitions and their subsequent analysis.

Used DataSet:

Thus, the Indian Cluster definitions which is prepared in reference to US Cluster definitions, is merged with the PLFS data set of each year, where NIC (5-digit) codes is used as the merging variable.

PLFS is a household-level survey undertaken to assess the labour market in India released by National Statistical Office (NSO). It collects data on various aspects, like the number of employed and unemployed persons, their demographic characteristics, the sector and industry they work in, their educational qualifications, and their wages and earnings. It captures both formal and informal aspect of the economic activities in the economy. The geographical coverage of the dataset is extensive as it covers the almost all the regions (districts) in the country. The survey is a longitudinal exercise and is available annually from year 2017-18 to 2020-21. Two major variables: number of employed people¹ and their yearly payroll² are extracted across all districts and cluster categories. These variables are also extracted with further bifurcation of sectors (rural and urban); gender (male and female); type of skills³ (skill I, skill II, skill III and skill IV) and type of employment⁴ (casual workers, self-employed and regular salaried workers). All the data is finally extracted in the format given below:



¹ Number of employed people were extracted using the status of usual principal activity.

² Total Payroll was calculated and extracted by summing the wage earnings of current weekly activity of the employed population.

³ The different type of skills has been created from the National Classification of Occupation- 2004 codes. Skill 4 and 3 are the high skilled workers, skill 2 and 1 reflects semi-skilled or low skilled workers.

⁴ Types of employment is identified and extracted using the status of usual principal activity.

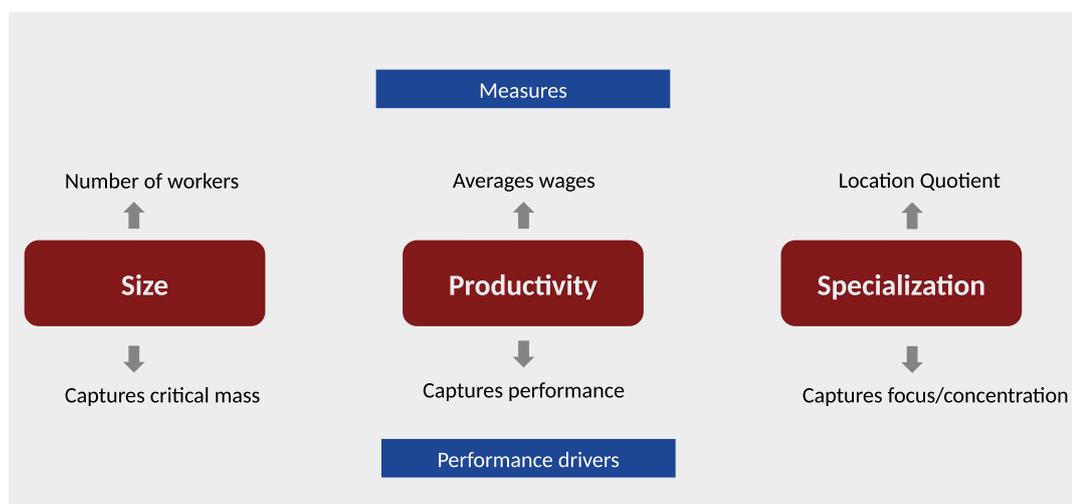
To make our analysis robust, we have used the data of four years: 2017-18, 2018-19, 2019-20 and 2020-21 and compiled it into one. If the data point was available for all the four years, an average of four was taken; if it was available for any three years, an average of three is taken; and so forth.

The employment status in the labour market is measured by two different approaches namely usual activity status and current weekly activity. The former measures activity status of a person during the reference period of 365 days preceding the date of survey and for the latter the reference period is of 7 days preceding the date of survey. In PLFS dataset, variable payroll is available only for the current weekly activity, however its corresponding NIC codes are at 2-digit level. On the other hand, NIC codes corresponding to the usual activity status is available at the 5-digit level. This constrain results in few data points where the payroll recorded is zero, even though there is positive employment. For such cases employment was made zero.

After this calculation, few cases of extreme outliers (the average wage of the region for the respective cluster was more than 9 times the national average for that same cluster) were identified and treated to arrive at the final dataset. The initial data was extracted at the district level, and then the final compiled dataset was summed up to arrive at the state-level figures for each variable across all the bifurcation of sectors, gender, type of skills and type of employment. This treated dataset is used throughout the paper for all the analysis.

Assessment of Cluster Strength:

The strength of a cluster (i.e., the presence of economic activity within a specific cluster category in a specific location) is measured along different dimensions of size, specialization and productivity, following (Ketels & Protsiv, 2014). The first two dimensions are employment-based indicators, measuring the absolute and relative size of employment. The absolute size of the cluster, measured by the number of workers, affects the number and the intensity of linkages of the cluster. However, since regions differs in geographical sizes, relative indicator 'Location Quotient' is used as another dimension. It measures the region's specialization in a cluster by capturing the degree of concentration of the cluster in a particular region with respect to the nation. It is computed as the ratio of a) share of region's cluster employment in its total employment b) share of cluster employment in overall nation's employment. The third-dimension employee's productivity is captured by annual average wages of the workforce. Wages reflect the productivity that a specific cluster achieves, they are driven both by cluster- and by location-specific factors.



The presence of different clusters is heterogeneously distributed among the different districts of the nation. Few clusters like coal mining, aerospace, metal mining, music and recording are concentrated in only few districts and others like agriculture, wood products, transportation and logistics are spread in more than 500 districts. As a result, each clusters had different number of active regions⁵. For each cluster, top 20% of the active districts were assigned a "star" (point) for each of the three dimensions.

For instant, if Mumbai Suburban district is in top 20% of the active region in size dimension of a particular cluster, it will be assigned in "1-star" category, but if it is in the top 20% in any two of the dimensions of the same cluster, it will be assigned to "2-stars" category and if the region is in top 20% in all the three dimensions, it will be assigned to "3-stars".

The strength of a region's cluster portfolio is measured by giving weights to the type of stars and finally summing them. The highest weight of three is given to "3-star cluster", followed by two and one. If a region has six "3 stars" clusters, fifteen "2 stars" clusters and twenty-five "1 star" cluster, the total cluster strength of the region will be 73 ($3*6+2*15+1*25$). The greater is the number of "stars", the higher is the cluster strength of the region.

The same methodology is followed to calculate the cluster strength of the districts as well as of the states.

The cluster strength is a multifaceted concept and partially reflects the accumulated competitiveness level of the region. Though each dimension used to calculate he cluster strength has some limitations. Large regions benefit in the size measure but have less likelihood to have high location quotient. Average wages are sometimes overestimated because of small size of the workforce in the region. However, these different possible limitations often work in opposite direction and reduce the overall biasness in the cluster strength.

⁵ Active region refers to the location with positive employment in the cluster category.

India's National Cluster Portfolio

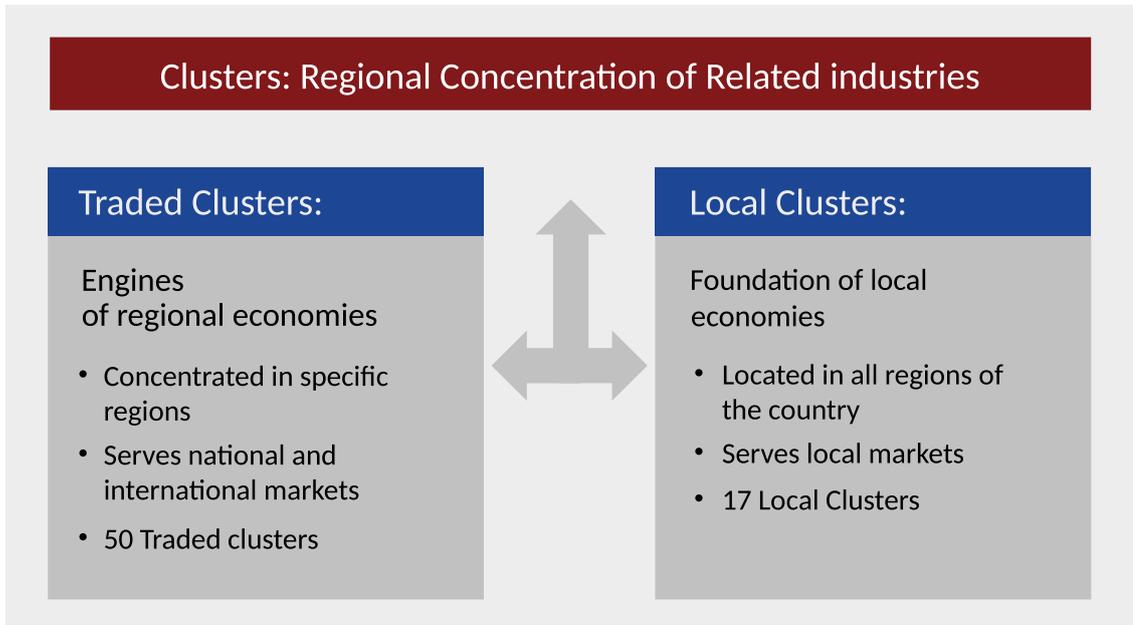
The employment landscape in India, a country renowned for its demographic diversity and burgeoning population of 1.3 billion people, holds immense significance for understanding its economic dynamics and social fabric. Analysing data extracted from the Periodic Labour Force Survey (PLFS) over a four-year period provides valuable insights into the employed labour market, shedding light on the distribution of workers, skill composition, and employment types. The dataset encompasses approximately 430 million workers, offering a comprehensive approximation of the country's employment landscape. Contrary to the perception that urban areas serve as the primary employment hubs, the majority of employment (70%) is concentrated in rural areas in the country. Interestingly, although urban areas offer higher wages on average, approximately twice that of rural areas, the majority of the workforce is still employed in rural regions. Delving into the skill composition of the workforce, India demonstrates a concentration of 57% skill 2 workers, followed by 23% skill 1 workers. Skill 2 workers typically encompass low and semi-skilled individuals. In contrast, high-skilled workers make up only 15% of the employed workforce. This distribution highlights the dominance of the low and semi-skilled workforce in the country, underscoring the need for efforts to enhance skill development and promote the growth of high-skilled occupations. Examining employment types, it is notable that half of the employed workforce in India is self-employed. This suggests a significant presence of individuals who work for themselves or own small businesses. Regular salaried workers account for 26% of the workforce. Casual workers represent the remaining portion of the employed workforce. The prominence of self-employment in India's labour market may be attributed to factors such as limited formal job opportunities, entrepreneurial spirit, and the prevalence of small-scale enterprises.

These findings shed light on the dynamics of India's labour market, showcasing the dominance of rural employment, the concentration of low and semi-skilled workers, and the prevalence of self-employment. However, examining labour market dynamics through disaggregated cluster categories is crucial for developing strategies that address market and sectoral gaps, promote formal employment, and foster inclusive economic growth. This approach would provide deeper insights into specific industries, identifying more specific gaps, and addresses regional disparities.

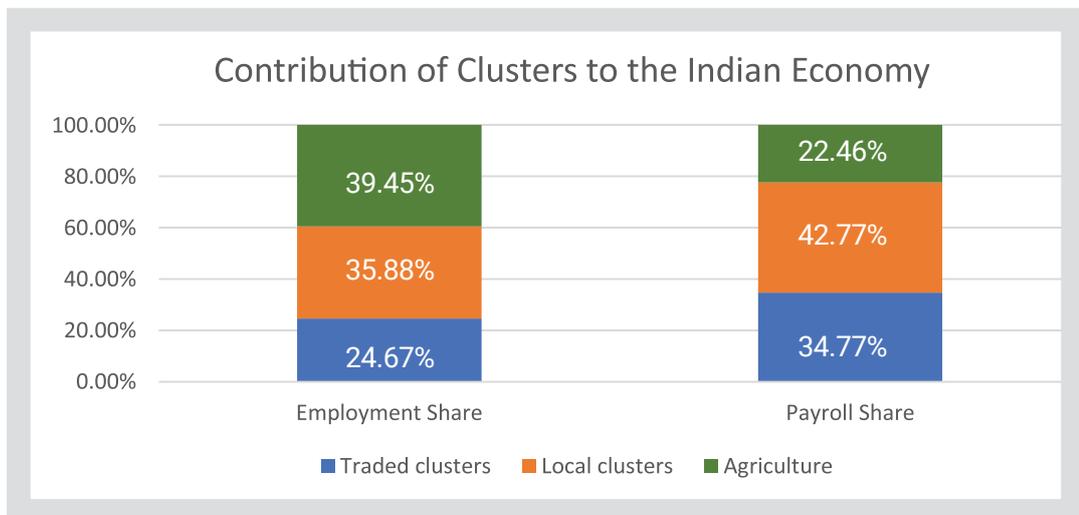
Broad Cluster Category:

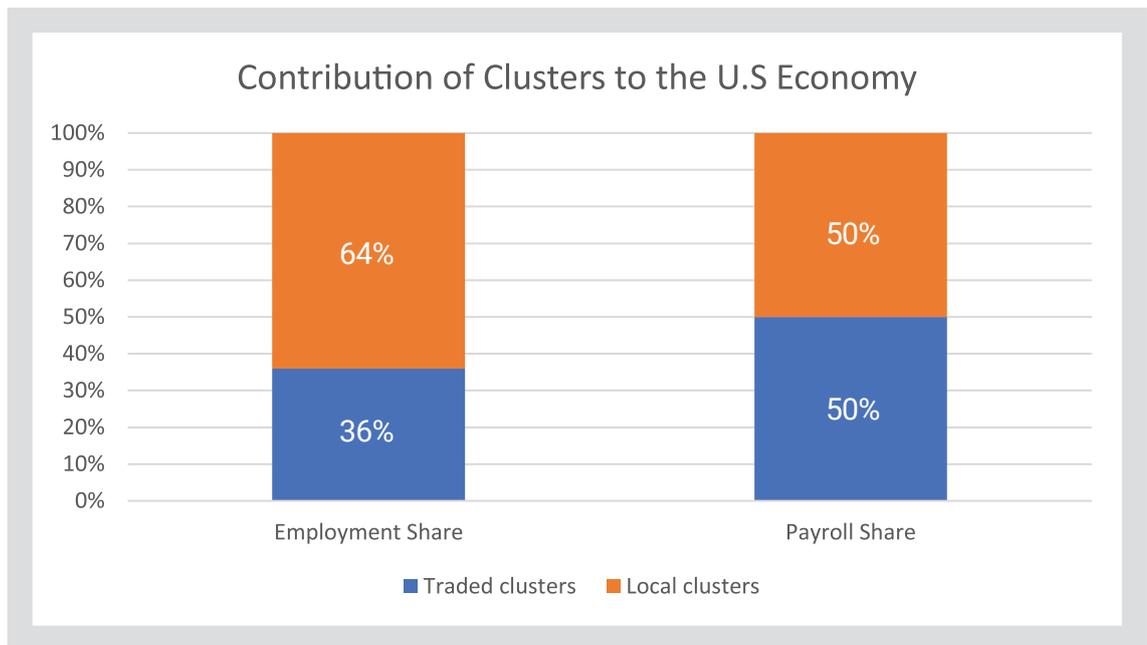
Economies worldwide classify the industries as traded or local under the cluster mapping initiative, depending upon the nature of the economic activity and the differences in their geographical footprint. The traded clusters show a clear concentration of employment in

a few locations having specific competitive advantages, while local clusters are relatively present in almost every part of the country. The former is characterized by competition and its presence in national and international trade. The latter produces goods and services serving the local market only, competing with the local competitors regardless of the competitive advantages of the location, if any. Local clusters maintain a strong and flourishing regional economy by offering essential services to the trading clusters in the area. As a result, the region's employment in local clusters is usually high and proportional to the population of that region.



The traded clusters are like the engine: if they are not successfully competing in national or international markets, a location cannot reach higher levels of prosperity. Whereas local clusters are like powertrains and tires; if they are not efficient and supportive, traded clusters are unable to lift the region's prosperity to higher levels (Ketels C., Cluster mapping as a tool for development, 2017).



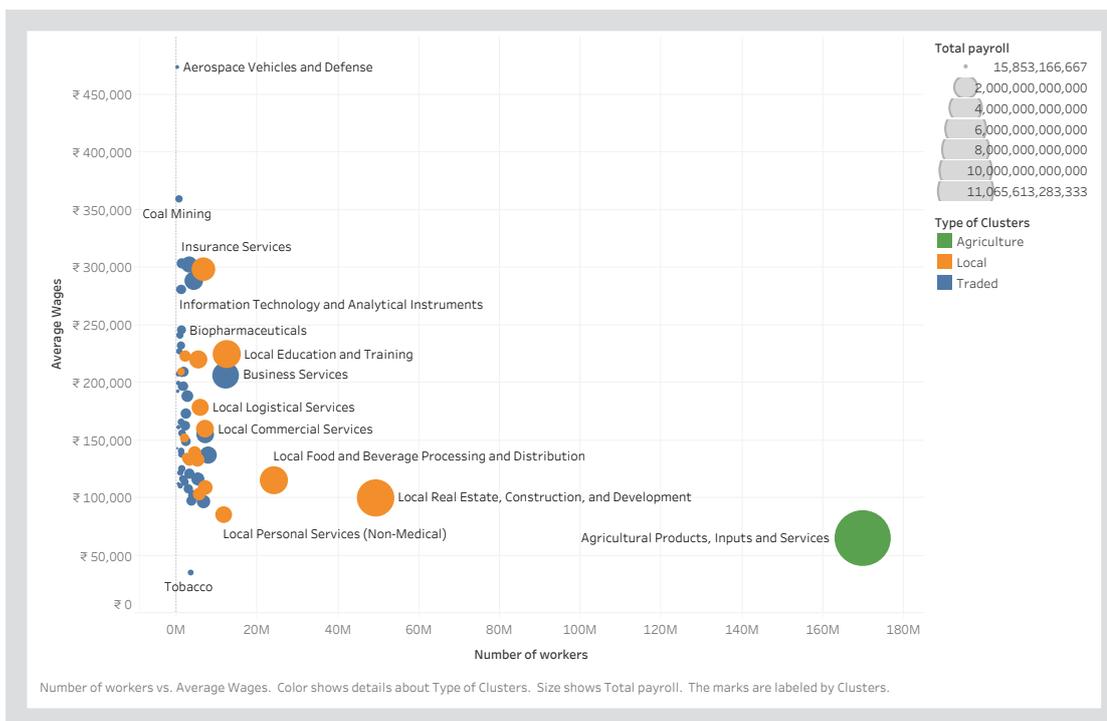


Traded clusters are considered to be the key engines of regional economies because of their high contribution to the national payroll, productivity, and innovation despite not being employment-intensive like local clusters. Similar pattern is observed in many developed countries like U.S, and Sweden. Traded clusters in U.S account for 36% of employment and 50% of the national payroll, highlighting their crucial role in driving economic growth. On the other hand, local clusters in the country have a larger share of employment (64%) compared to traded clusters, indicating their importance in generating job opportunities across different regions of the country.

India's economy presents a slightly different economic landscape compared to other national economies. Traded cluster share in national payroll is approximately 35%, which is significantly less than their contribution in other national economies. However, this still underscores the significance of traded clusters in India's economy. The data also draws attention to the importance of the agriculture cluster in India. Despite contributing only 22% to the national payroll, the agriculture sector employs a substantial portion of the workforce, accounting for 39.5% of employment. This suggests that the agriculture sector in the country has a higher employment intensity, but lower average wages compared to other clusters. Local clusters have a high share in total employment as well as total payroll of the country, which signifies their ability to generate jobs and support livelihoods for a large portion of the Indian population.

Narrow Cluster Categories:

Further bifurcations of broad cluster categories: traded clusters, local clusters and agriculture into 68 narrow cluster categories provide a more granular perspective of the national and regional economy of India.



The above figure is the cluster portfolio of India, which highlights the position of each of the 68 cluster categories in terms of employment, payroll and average wages. The snapshot further confirms the empirical literature, which states that traded clusters contribute significantly to productivity and economic well-being, whereas the local clusters (including agriculture here) drive up the size of the economy.

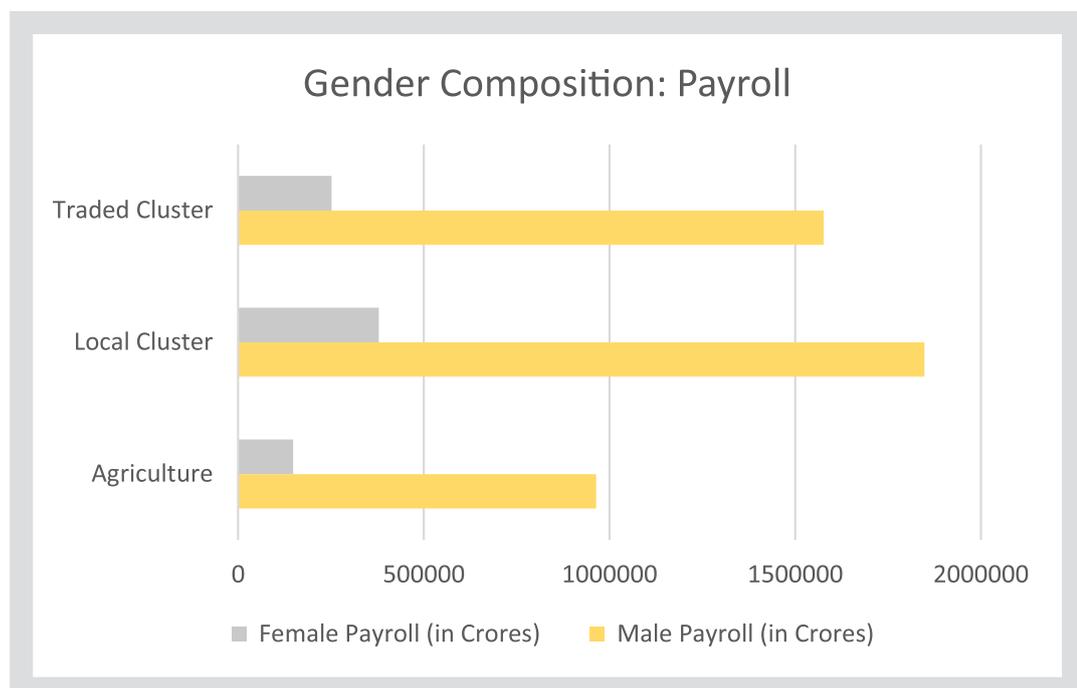
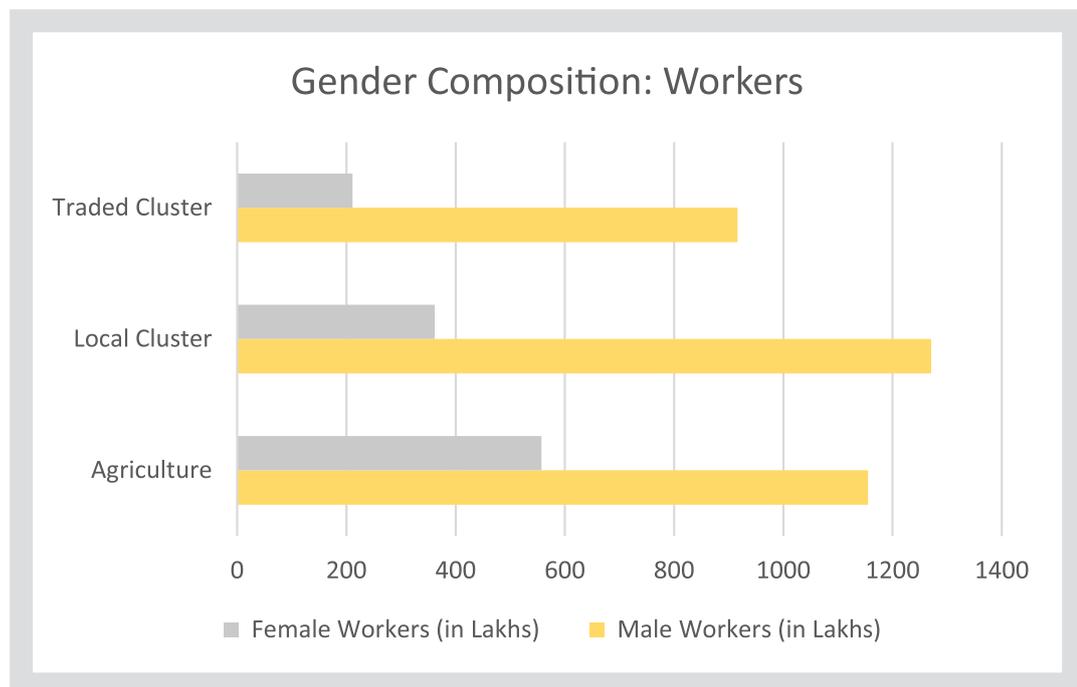
Even among all the narrow clusters, agricultural cluster in India has a significant workforce, which aligns with India's status as an agrarian economy. Other notable clusters with a substantial workforce include Local Education and Training, Business Services, Local Government, and Local Commercial Services, which reflect sectors that require a significant labour force, such as education, administrative services, and public services. Clusters like Aerospace Vehicles and Defense, Coal Mining, Oil and Gas Production and Transportation are typically capital-intensive and highly specialized, which explains their relatively lower employment numbers and higher average wages compared to other clusters.

In terms of average wages, most of the traded and local clusters have productivity above the national average (Rs 1.14 lakhs). This suggests that the wage patterns within traded clusters in India reflect the capital and skill-intensive nature of these industries. Traded clusters are typically more integrated into the global economy because of their export contribution and thus are subject to international competition, which can influence their productivity and ultimately wage levels. Surprisingly, high average wage levels are observed among few local clusters like the Local Government, indicating that government jobs may offer additional perks and remuneration compared to other clusters. It also aligns with the common perception that government positions often come with benefits and relatively stable income in the country.

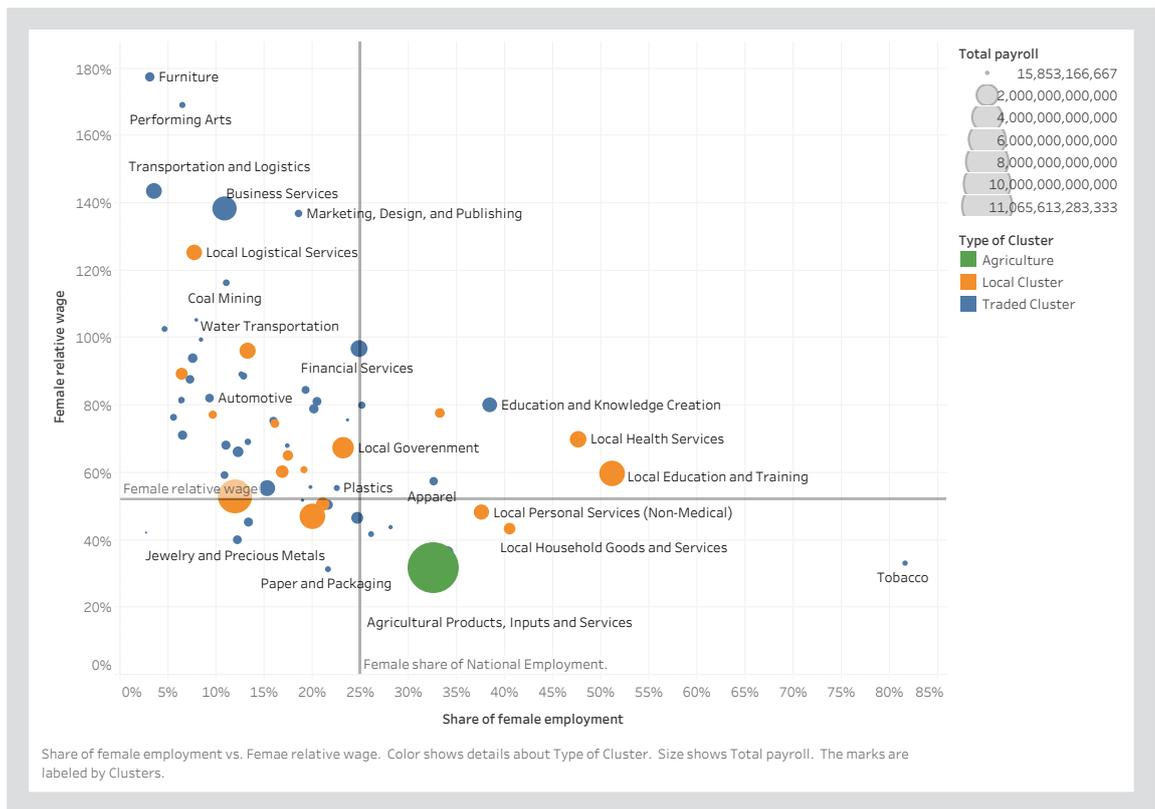
However, there are significant variations in the average wages within the cluster categories. Among the traded clusters, average wages range from as high as Rs 4.73 lakhs in the Aerospace Vehicles and Defense cluster to as low as Rs 0.35 lakhs in the Tobacco cluster. Similarly, within local clusters, average wages range from Rs 2.98 lakhs in Local Government to Rs 0.85 lakhs in Local Personal Services (Non-Medical). This wide range of average wages across different clusters might be the result of variations in capital and skill intensity within sectors. Industries with higher capital investment and specialized skills tend to offer higher wages, while others may have lower wage levels due to factors such as labour intensity or lower skill requirements. However, it is worth highlighting that the wage gap is more pronounced in the traded clusters, where the differential between the highest and lowest average wages is approximately 13.5 times, compared to a 3.5 times disparity observed within the local clusters.

Cluster Composition:

Gender:

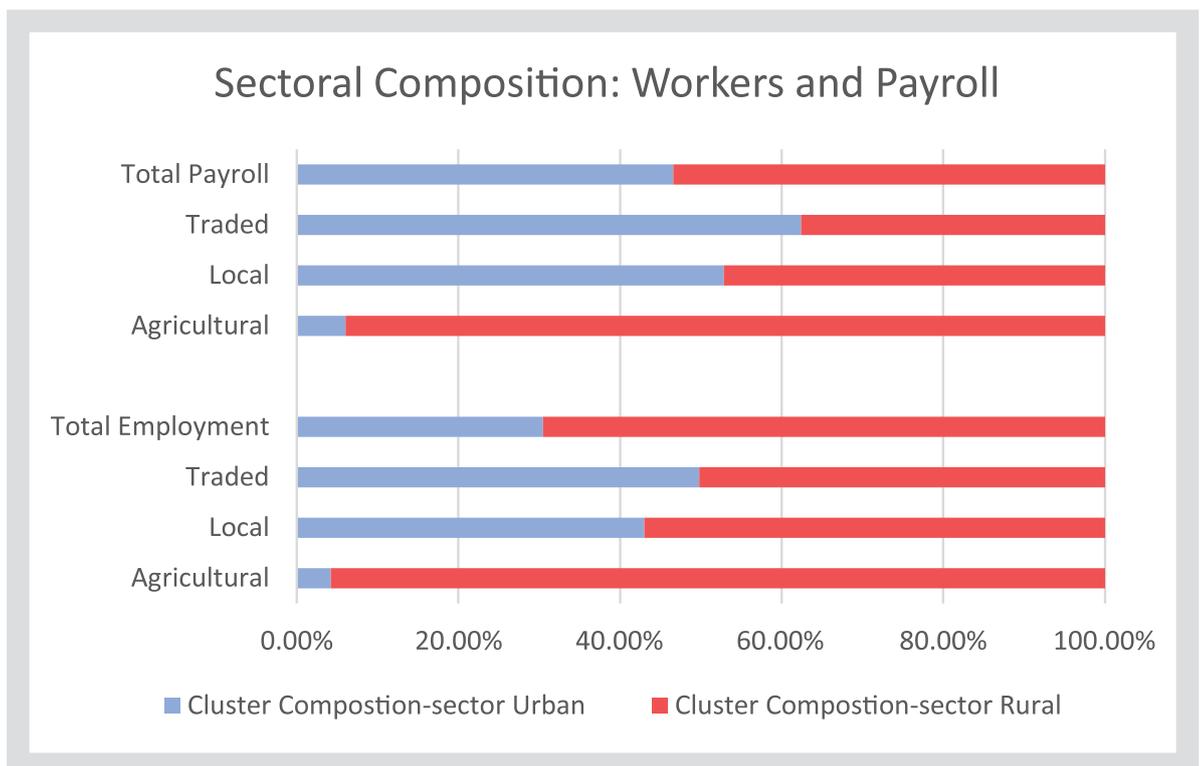


A breakdown of the employed workforce by gender confirms the image of India's labour market as gender segregated. On average, the labour market comprises 75% males and only 25% females, although each cluster has a different distribution at both broad and narrow categories. Agriculture, followed by local clusters, has the highest share of females, about 33% and 22% of the workforce, respectively. However, the female share in total payroll remains below 20% in all three types of cluster categories. The gap becomes more significant among the narrow cluster categories. Clusters in the bottom right of the quadrant are among the few clusters where the share of female employment is greater than the national average of 25.5% in the country.



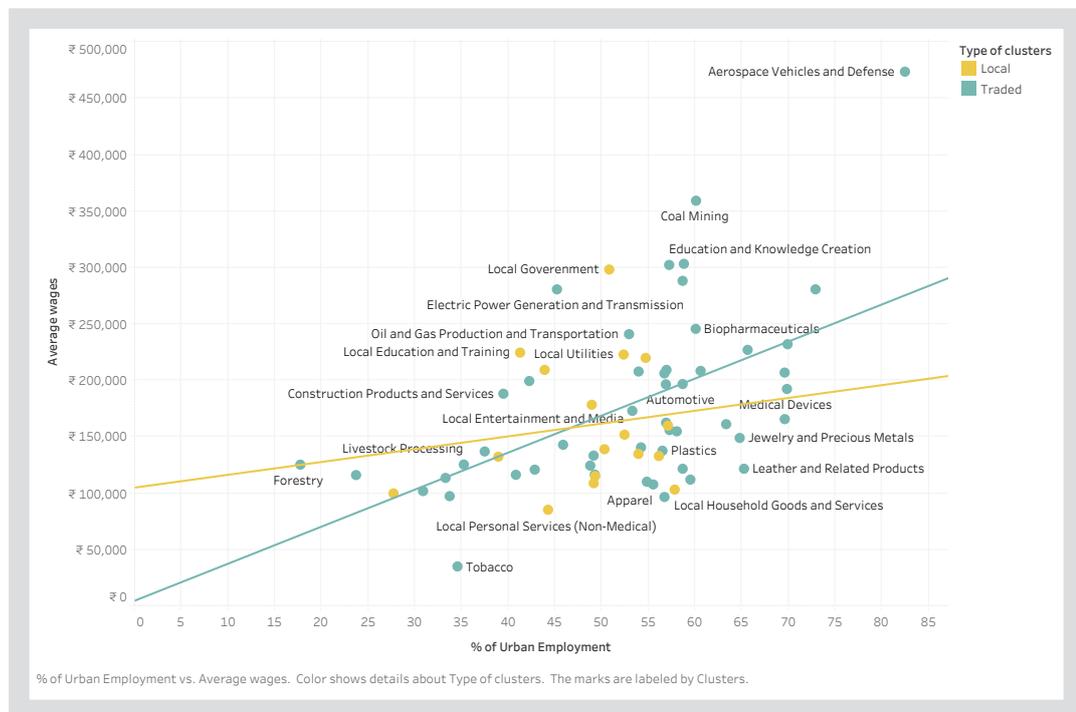
Sector:

The urbanization rate is a crucial element of economic geography and development, as urban areas are the key sources of economic performance and dynamism of the country. However, it is considerably slow in India. The projected rate of urbanization by 2023 is about 35.07%, according to the National Commission on Population, Ministry of Health & Family Welfare. Additionally, as per the used data, only 85 districts of 680 had greater than 50% of employment in its urban areas.

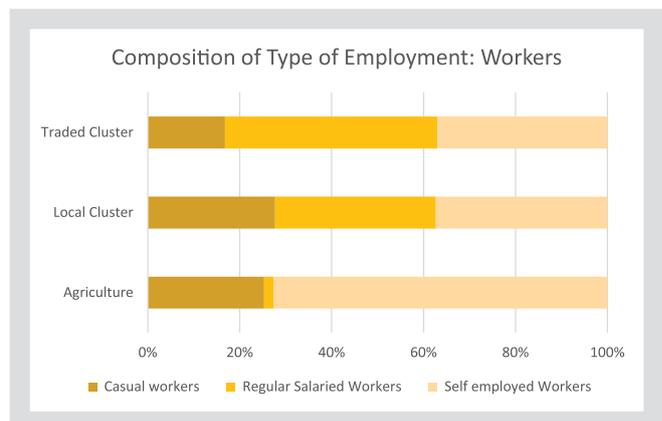
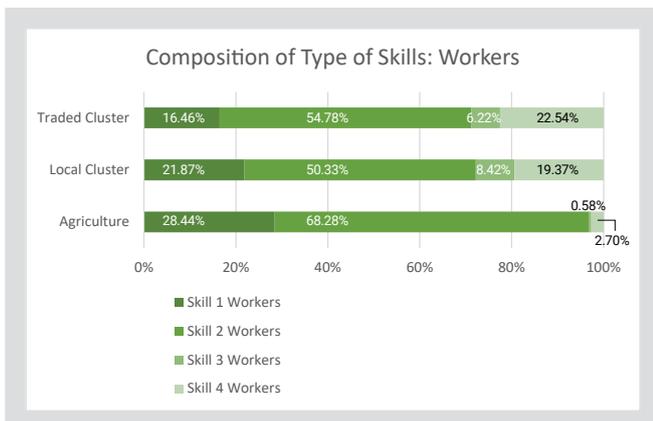


According to the overall economy's sectoral distribution, only 30.5% of jobs are in the urban sector, which accounts for around 47% of the national payroll. The cluster lens provides important insights into these unusual dynamics in India, particularly as it is greatly affected by the presence of agriculture in the country. Agriculture provides employment in the rural-dominated parts of the country and is also the primary source of income in these areas.

While traded and local clusters are well-represented in rural areas, the majority of their payroll is concentrated in the urban sector of the country. Most of the traded clusters are dominated by the urban sector, both in terms of employment and wage earnings. Clusters that are resource-dependent, such as forestry, tobacco, non-metallic mining, and wood products are the few exceptions to this trend. On the other hand, the share of employment in local clusters is about equally present in both the urban and rural sectors, but a large share of the payroll is primarily concentrated in the urban sector. Only 26 and 14 cluster categories have a degree of urbanization in terms of employment and payroll, respectively, that is less than 50%. These clusters are mainly resource-dependent and include Agriculture, Non-metallic mining, Forestry, Vulcanized and Fired Materials, and others. Further findings at the narrow cluster categories show that a greater concentration of urban employment is positively correlated with higher average levels at both local and traded levels.



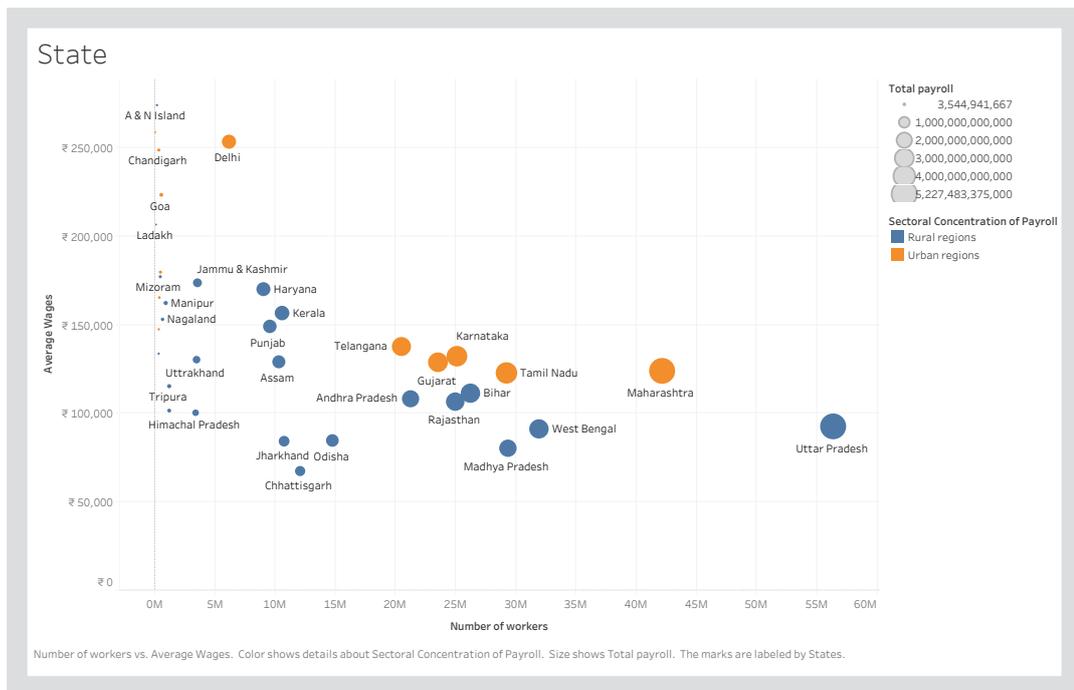
Type of Skill level and Employment:



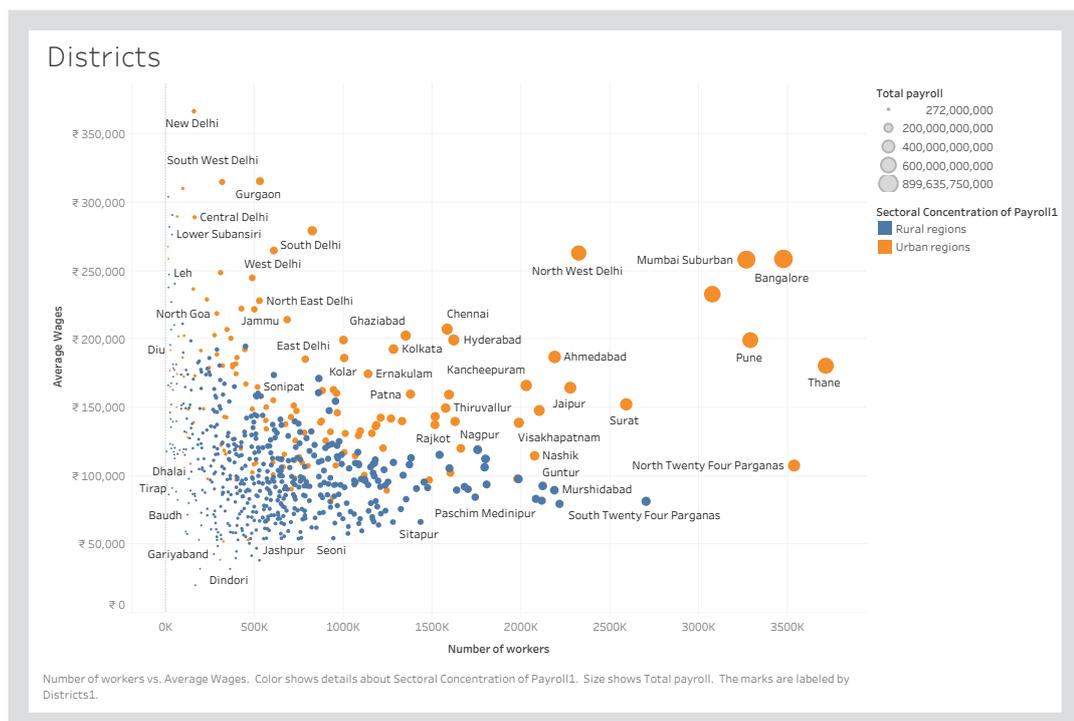
The Economic Geography of India through a Cluster lens

India exhibits significant heterogeneity among its regions, including states and districts, in terms of their economic performances. The country's vast geographic expanse, diverse demographics, and varying levels of development contribute to a diverse economic landscape. Understanding this heterogeneity is crucial for policymakers, economists, and analysts to formulate effective strategies and policies that address the unique needs and challenges faced by different regions. When examining the economic performances of states and districts in India, one can observe stark disparities in key indicators such as GDP growth, industrial development, infrastructure, employment opportunities, and per capita income. According to RBI data, Goa is 9.6 times more prosperous than Bihar, as measured by GDP per capita (2019-20). The significant difference at the regional level in terms of prosperity is further magnified when we move from the state to the district level. The most prosperous district has 18 times higher average wage than the least prosperous district, as calculated by the used data. Similar differences are visible in graphs below. It provides a glimpse into the diverse labour market landscape in India at the granular geographical level of states and districts, highlighting variations in employment, wages, and sectoral concentrations.

Larger states like Uttar Pradesh and Maharashtra have substantial numbers of workers and high total payrolls, likely due to their large population sizes. On the other hand, smaller states like Sikkim and Lakshadweep have relatively fewer workers and lower total payrolls. States like Gujarat, Maharashtra, and Tamil Nadu exhibit high total payrolls, indicating strong economic activity and more employment in urban regions. In contrast, states like Arunachal Pradesh and Mizoram have relatively lower total payrolls, suggesting potential challenges in generating higher employment opportunities. Average wages vary across states, with urban regions generally having higher average wages compared to rural regions. Smaller states/UTs like Chandigarh, Delhi, and Goa stand out with relatively high average wages, while states like relatively larger states like Odisha and Madhya Pradesh have lower average wages, as majority of the share is concentrated in their rural areas.



When examining the same variables at a more granular level of districts, interesting insights emerge. Most districts with a large number of workers or high average wages tend to have a higher concentration of payroll in urban areas. This suggests that urban regions within districts play a significant role in driving their economic activity by offering better job opportunities and generating higher wages. They serve as hubs for industries, services, and commerce, attracting a larger share of the payroll. It further highlights the importance of urbanization and urban economic centres in driving the regional disparities and the need for comprehensive strategies that promote inclusive growth, strengthen rural economies, and create opportunities for sustainable development in both rural and urban areas.

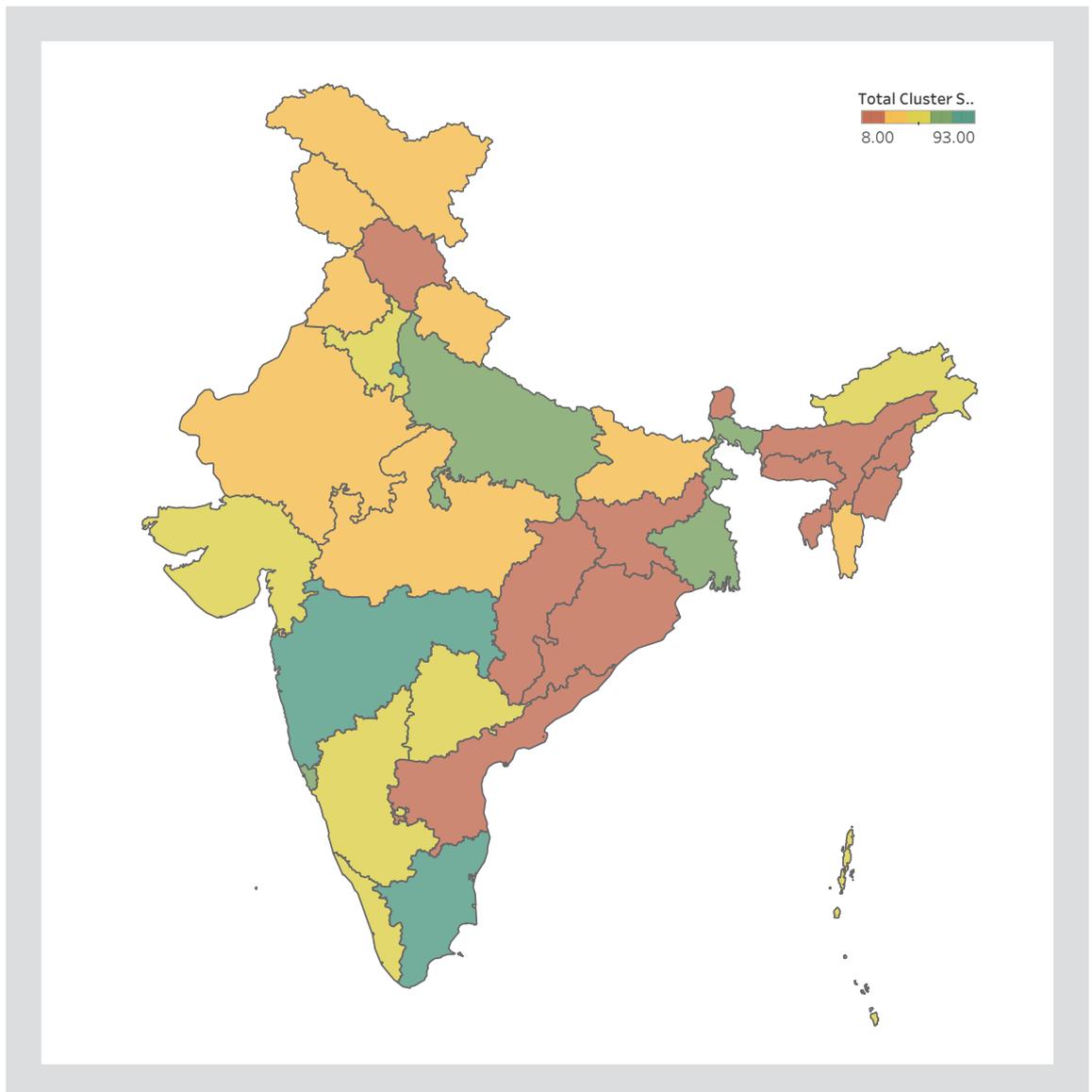


Cluster Presence and Economic Performance:

Significant variation in the economic performance of the regions within a country is a striking yet common feature in all the world's major economies. India is no exception to it, as explained previously. There exist large disparities in economic performances and prosperity levels among states and districts across the country. In this section, we explore why these regional economies differ significantly from each other in terms of productivity and prosperity through the cluster strength of the region and the role of business environment. The geographical patterns of cluster concentration is identified across regions using the 'total number of stars' measure of cluster portfolio strength outlined in the previous section of the methodology.

State Level:

The graph highlights the hotspots region in the country at the state level.



The distribution of cluster strength across 36 states/union territories further confirms the vast economic disparity in the country. The high GDP states like Maharashtra, Tamil Nadu, Gujarat, Karnataka, Uttar Pradesh, West Bengal, Haryana and a few others show cluster strength greater than 50. In comparison, the bottom ten states with the lowest cluster strength are the less prosperous regions. The table below presents the cluster strength and its composition for each state.

State	3 Star	2 Star	1 Star	Total Cluster Strength
Delhi	3	30	24	93
Maharashtra	0	15	50	80
Tamil Nadu	0	18	43	79
Goa	0	23	26	72
West Bengal	0	10	45	65
Uttar Pradesh	0	2	58	62
Chandigarh	0	17	27	61
Gujarat	2	13	23	55
Haryana	2	14	19	53
Karnataka	0	7	31	51
Kerala	0	10	27	47
Telangana	0	12	23	47
A & N Island	0	12	21	45
Puducherry	0	4	35	43
Arunachal Pradesh	0	5	32	42
Punjab	1	6	25	40
Madhya Pradesh	0	6	26	38
Rajasthan	0	8	21	37
Lakshadweep	0	8	19	35
Daman & Diu and Dadra & Nagar Haveli	0	2	30	34
Bihar	0	6	21	33
Ladakh	0	6	21	33
Mizoram	0	2	29	33
Jammu & Kashmir	0	1	27	29
Uttarakhand	0	2	21	25
Nagaland	0	2	19	23
Andhra Pradesh	0	5	12	22
Manipur	0	1	20	22
Sikkim	0	0	21	21
Assam	1	2	12	19
Jharkhand	1	4	7	18
Odisha	0	3	7	16
Chhattisgarh	0	1	11	13
Tripura	0	0	10	10
Meghalaya	0	0	9	9
Himachal Pradesh	0	0	8	8

Assessment of Business Environment:

Given the myriad locational influence on productivity and its growth, capturing the nature of the business environment in a location is difficult. Nonetheless, it is important to identify the elements of the regional environment to understand the role of clusters in improving the competitiveness of the firms and the overall region. It is because clusters' existence and performance in a region are greatly affected by the enabling and supporting ecosystem in which it operates. Empirically, clusters are seen to flourish where the combination of specific business environment qualities creates unique value for a specific set of related industries. Firms can make themselves productive in any type of industry, given they use advanced technology, employ sophisticated production methods, and offer unique products and services. However, the sophistication with which firms compete in a location is significantly dependent on the quality of the business environment. Firms cannot adapt to advanced logistical techniques or work efficiently without the presence of good-quality transportation infrastructure and effective law and order in the region. All industries are impacted by some common business environments elements, such as the transportation system, corporation tax rates, income distribution and the legal system. Thus, clusters cannot be seen in isolation of the broader theory of competitiveness.

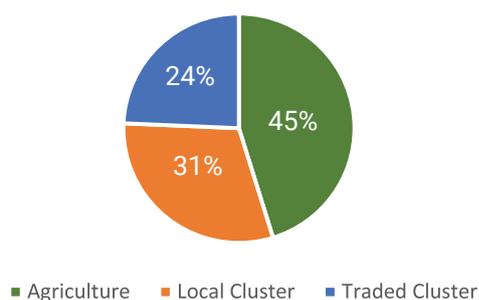
To highlight the importance of the business environment in achieving a strong cluster portfolio having high cluster strength along with regional competitiveness, we examine two states: Maharashtra and Uttar Pradesh. Both states have a strong cluster strength of 80 and 62, respectively. However, the former is driven by the two-star and one-star clusters and the latter by one-star clusters. It indicates that most of the clusters in Uttar Pradesh have been able to compete with rest of the region's clusters in only one of the following dimensions of cluster strength: Size, Average Wages and Location Quotient. Given that the two states have similar geographical size, demographic features, and presence of all 68 clusters, exploring their business environment is pivotal to understanding the difference in their economic performance.

	Parameters	Maharashtra	Uttar Pradesh
Factor Conditions	Logistics Ease Across Different States	3.32	3.25
	Patents filed	4741	1176
	Number of private R&D	1378	229
	State-wise Capital Expenditure	Rs. 1,04,829 Cr	Rs. 1,44,540 Cr
Demand Conditions	Degree of Urbanization	48.26%	23.88%
	Population in the highest wealth quantiles	27.90%	17.80%
	State GST collection	Rs. 1,49,271.49 Cr	Rs. 54,858.01 Cr
Context for Strategy	FDI Equity Inflows	2,88,905 Cr	6,481 Cr
	Factories in Operation	25610	16184
	Availability of Land	19749.97 Ha	3416.27 Ha
	Export Value	Rs. 5,45,083 Cr	Rs. 1,56,897 Cr
Related and Supporting Industries	Number of Special Economic Zones	37	14
	Number of MSME	25,04,408	11,10,173

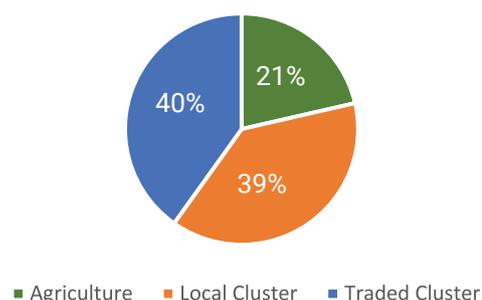
The above tables summarize the information on key variables forming the business environment in both states. On comparing the numbers, we observe a substantial difference in almost all the parameters, which indicates that Maharashtra has a more conducive business environment than Uttar Pradesh. This enables deep and diverse cluster portfolio formation in the region, especially of traded clusters. The traded cluster's contribution in terms of employment and payroll is greater in Maharashtra than in Uttar Pradesh, as depicted in the below graphs.

MAHARASHTRA

Worker's Distribution

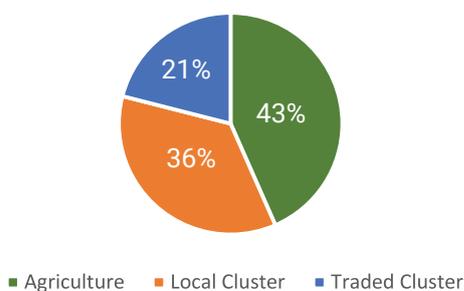


Payroll's Distribution

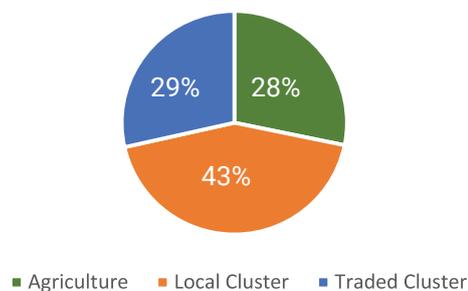


UTTAR PRADESH

Worker's Distribution



Payroll's Distribution



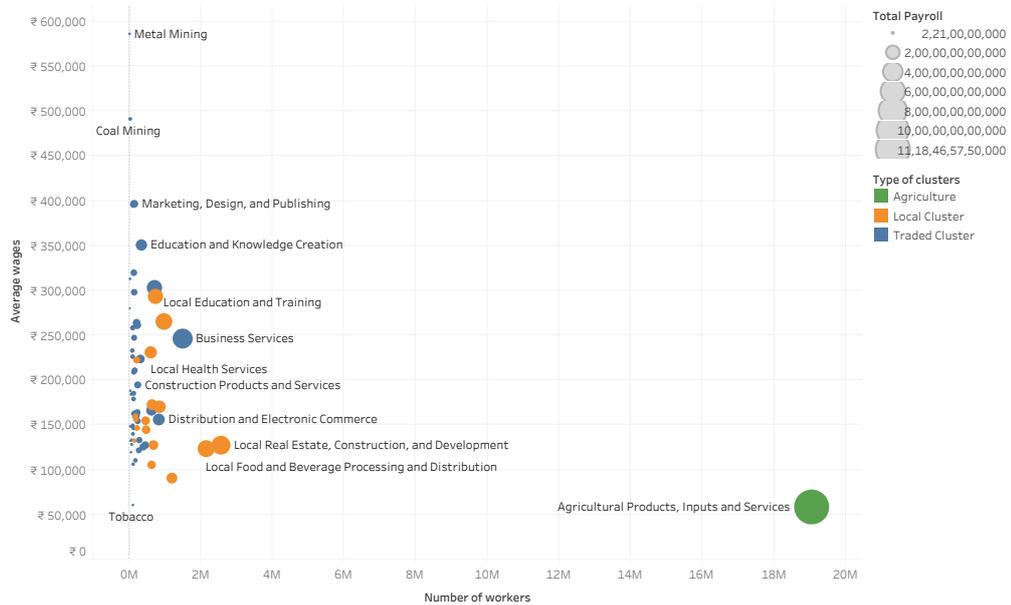
Each of the two states has a distinct cluster portfolio, as presented in the snapshots below.

Maharashtra's cluster profile is dominated by the mining of natural resources: Metal and Coal in terms of productivity. The average wages of the two clusters are greater than the national average, which is approximately 2 lakhs and 3.6 lakhs, respectively. It can be associated with the high export value of iron, steel products and precious, semi-precious stones.

Uttar Pradesh's cluster profile is more dominated by agriculture and related clusters like Textile and Food processing in terms of employment. Major exports of the region include cotton products, textile and processed foods, which provides high employment opportunities in such clusters.

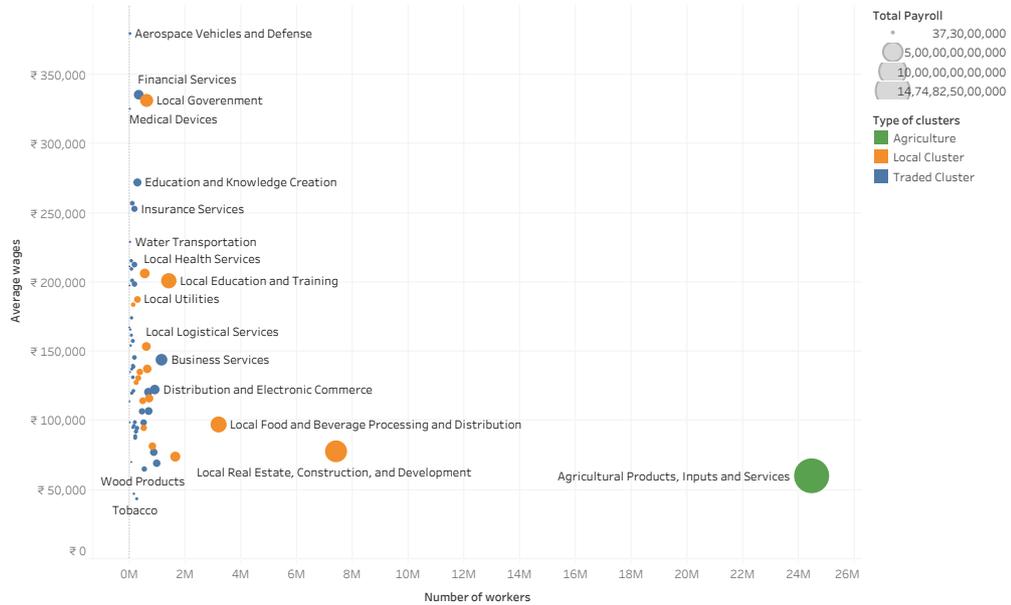
MAHARASHTRA

Landscape



UTTAR PRADESH

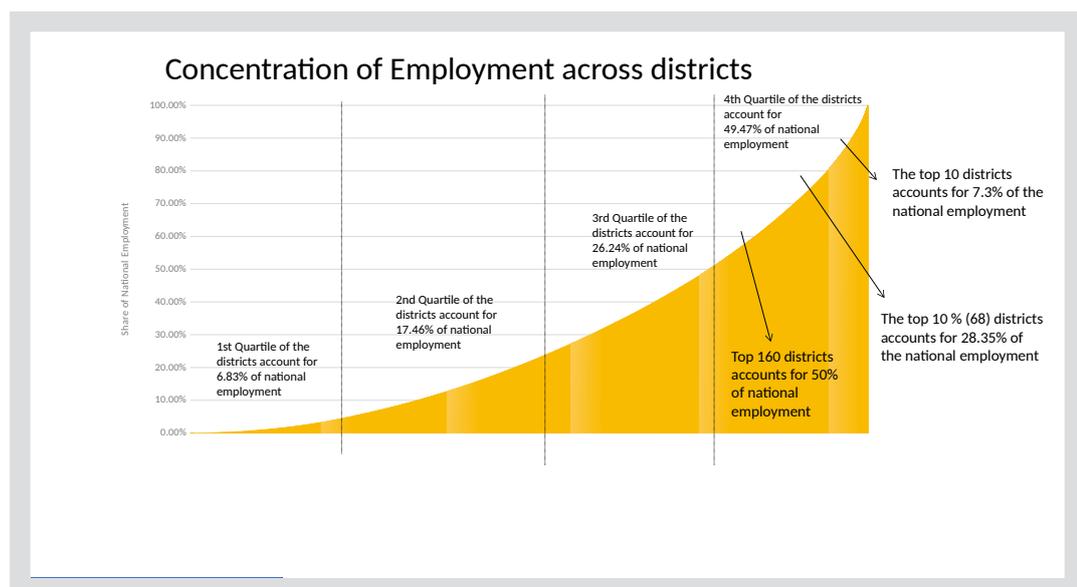
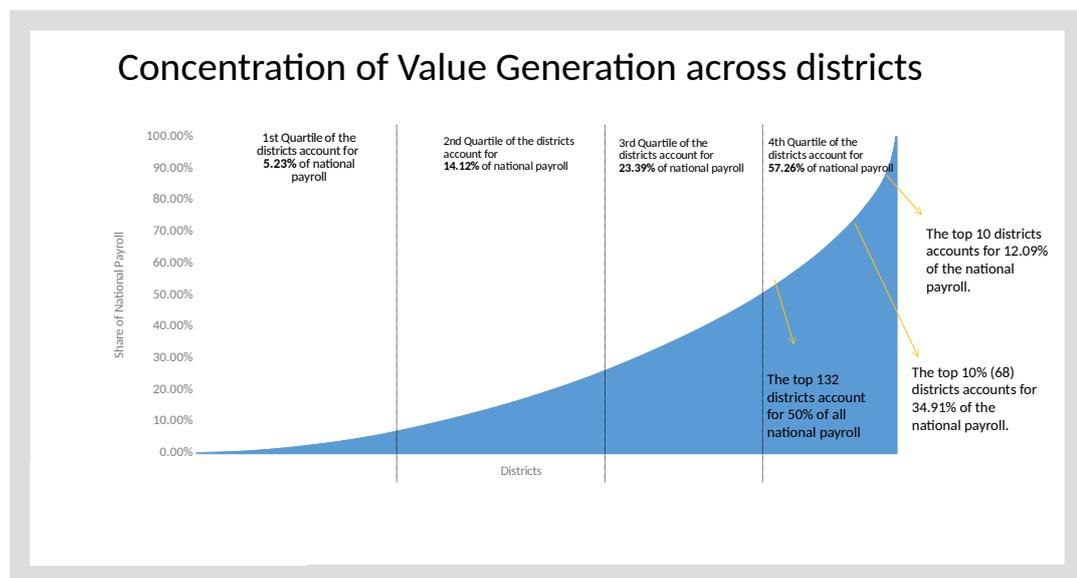
Landscape



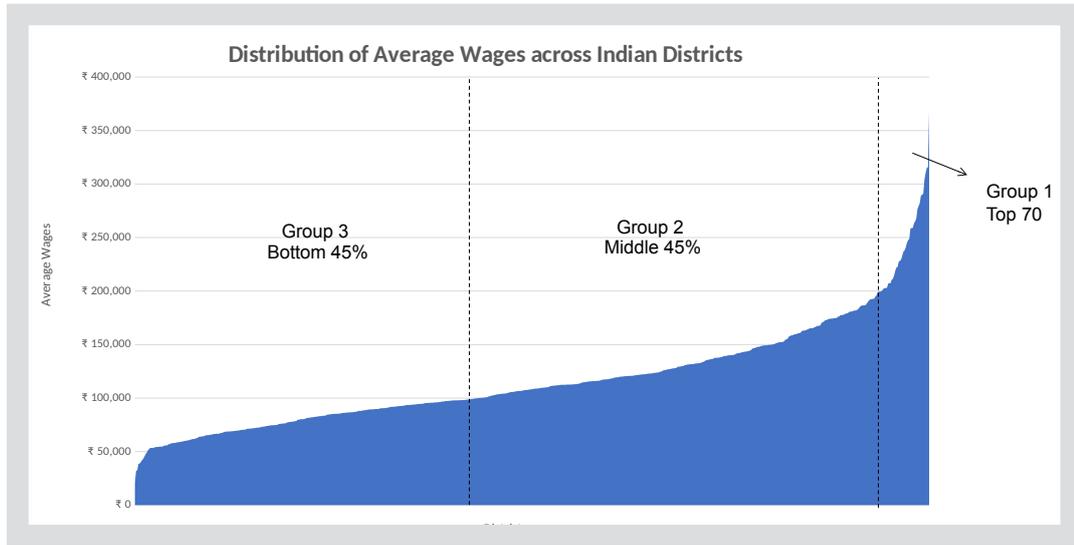
Similar to the above two states, all other states/UTs can be seen through the lens of clusters in the presence of their business environment to understand their current economic profile. The same can also be used to identify the Strength, Weaknesses, Opportunities, and Threats present in the regional economy.

District Level:

Vast differences are visible in the districts' value generation concentration also, which here is measured by the share of payroll (total wages). A total number of 680 districts are divided into quartiles. The upper quartile of the districts seems to be the hub of the vast economic activities as its contribution to employment, and payroll stands at 49.47% and 57.26%, respectively. On the other hand, districts in the lower quartile have a very low concentration of economic activities, contributing merely 6.83% and 5.23% to the national employment and payroll.



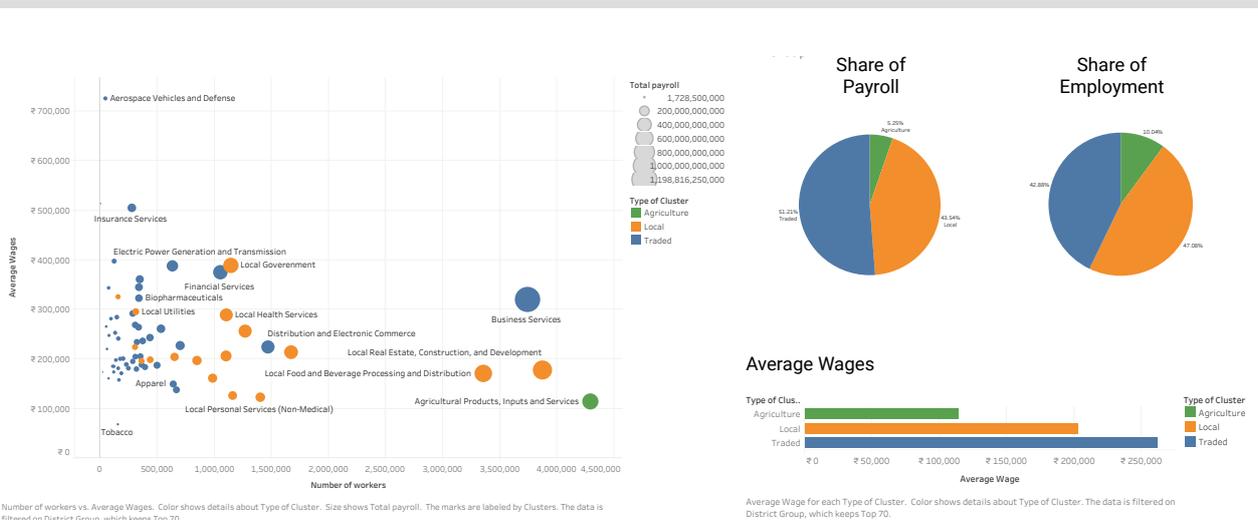
For ease of understanding, 680 districts have been grouped into one of the three categories: Top 70, Middle and Bottom, based on their average wages, which here is a measure of prosperity. The Top 70 group is the most prosperous set of districts, while the bottom group comprises districts that are the least prosperous.



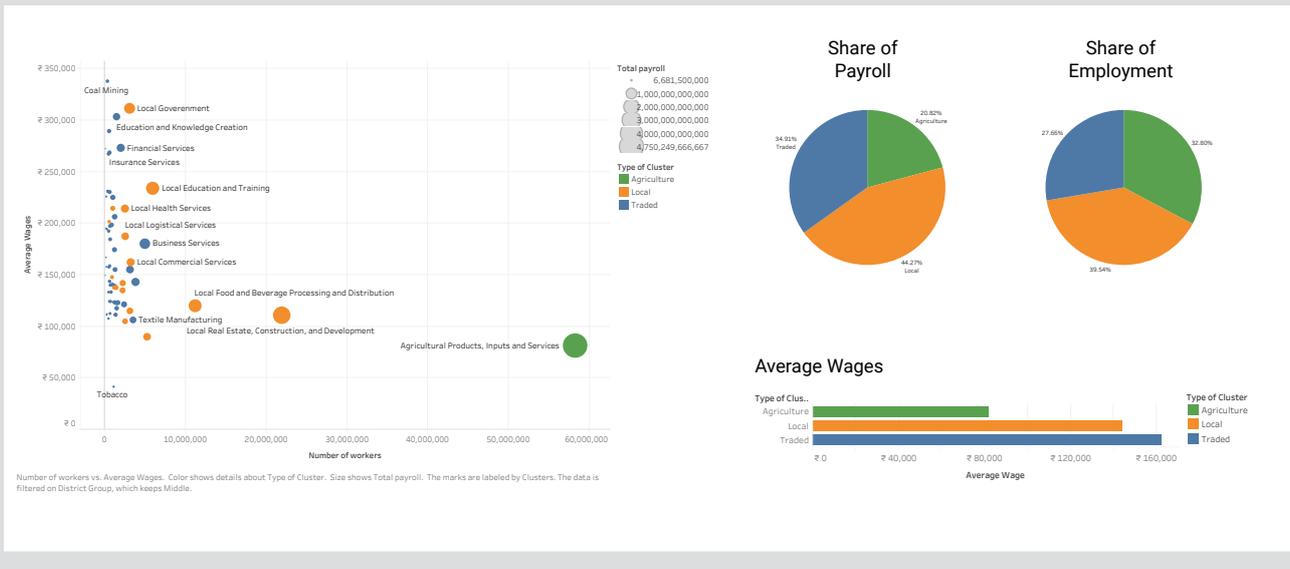
Cluster Portfolio

The economic disparity among the district can further be understood by analysing the cluster portfolio of the three groups of districts mention above. It is seen that each type of district group (which represents a different level of economic development) have a unique co-existence pattern of traded and local clusters. It is primarily the result of other micro-environment factors and natural endowments present in the regions. It is illustrated in the graphs given below.

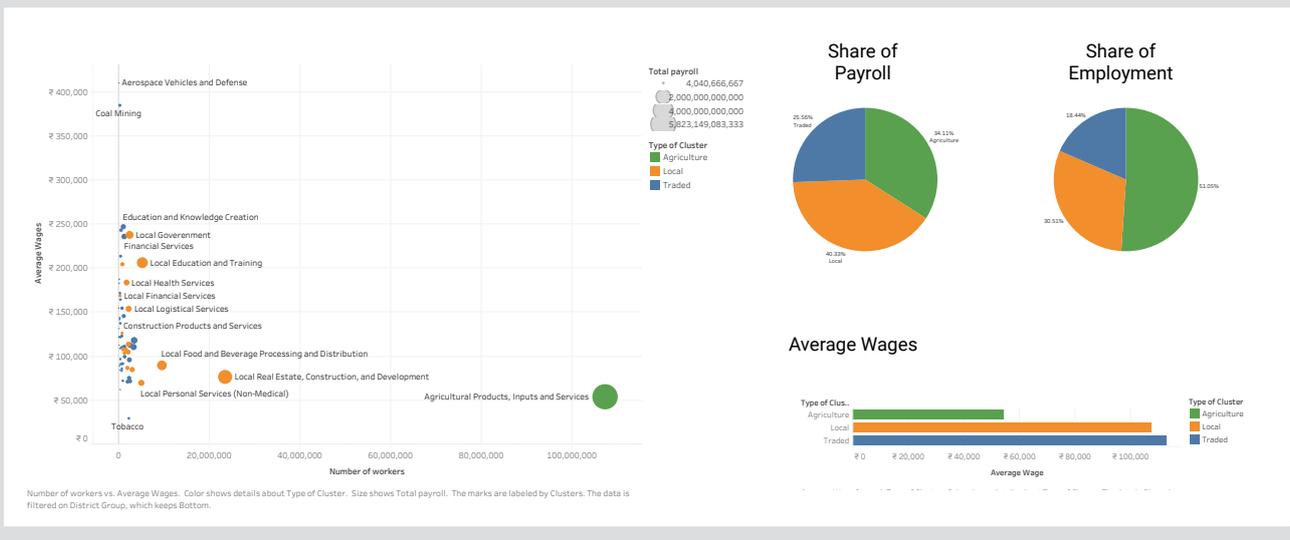
Top 70:



Middle:

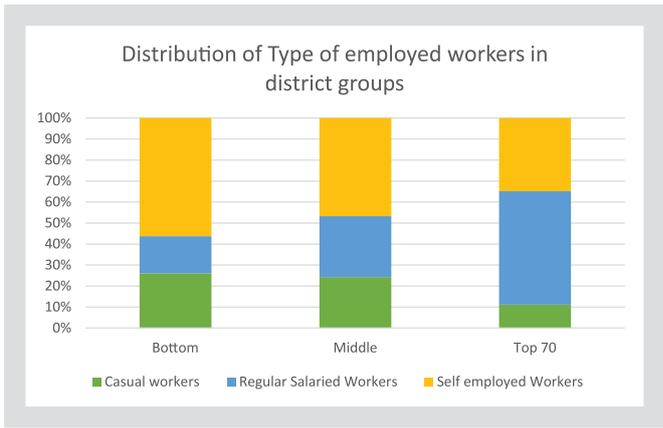
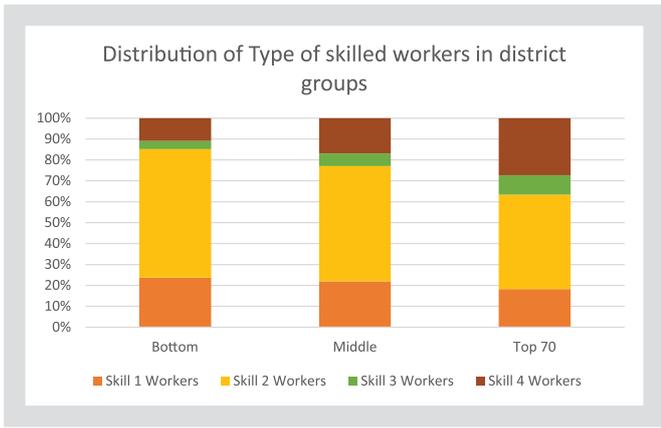


Bottom:

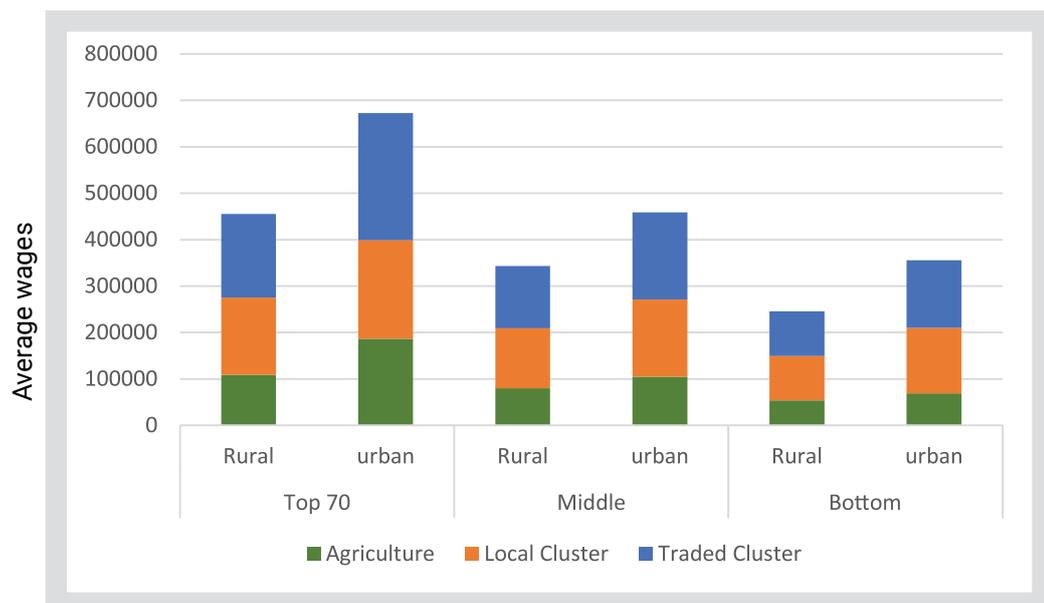
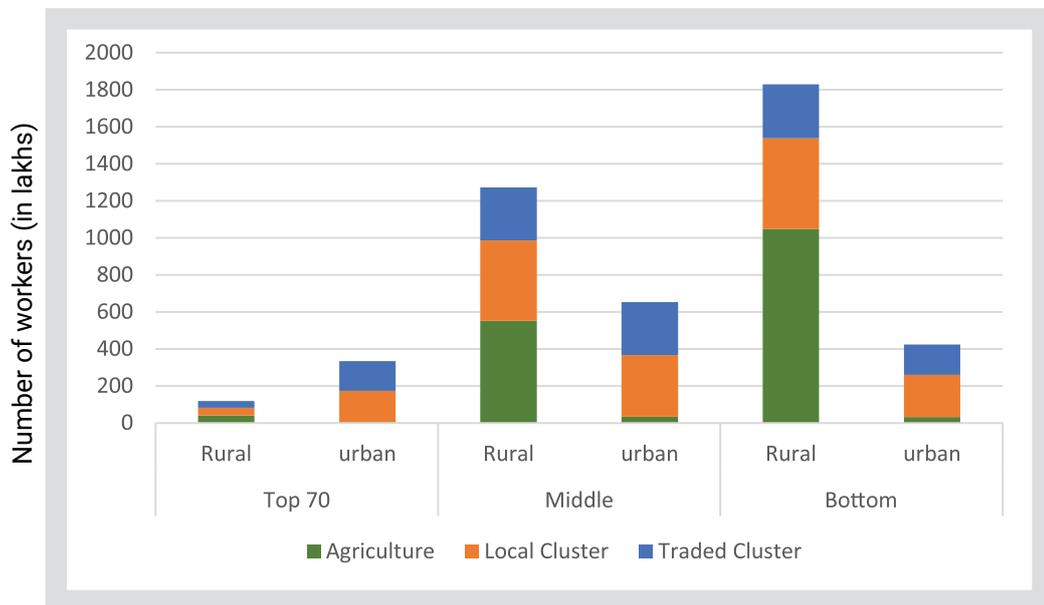


The contribution of traded clusters in payroll and employment increases significantly as we move up from the lower prosperity group. In the top 70 group, the average wage of traded cluster category is about 30% greater than the local average wage. In comparison, they are almost similar in the middle and bottom categories of districts. In all three groups, agriculture forms one of the crucial clusters as it provides the highest employment. The payroll share of agriculture is about six times higher in the bottom category compared to the top 70. However, its average wage is substantially lower than the traded and local clusters across all the districts in the group. Given snapshots also depicts the presence of different type of narrow clusters and their position in terms of employment and average wages across all three groups.

Each group has a peculiar cluster portfolio composition in terms of sector, gender, skills, and type of employment. It highlights significant differences among the three groups. The bottom group have a greater concentration of clusters which primarily compete on natural resources and abundant low-skilled labour, whereas the prosperous group (top 70) is strongly associated with clusters which are capital and high-skill driven. This is evident from the data used, which shows that more than 75% of the workers in the bottom and middle districts are skill 1 and 2 workers. They are considered to be low-skilled workers. In contrast the top 70 group have a substantial portion of workers as skilled 3 and 4, which are considered medium and high skill workers. Also, more than 50% of the workers are regular salaried employees in the prosperous group.

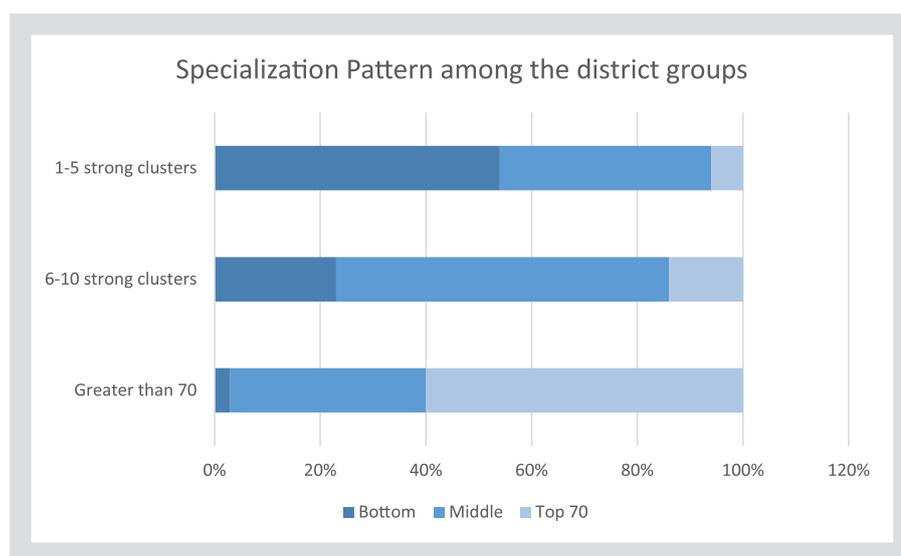


The urban-rural divide can also be seen as a key dimension to understand the significant heterogeneity of economic outcomes and performances across districts. All three groups of districts consist of both rural and urban regions but in different proportions.



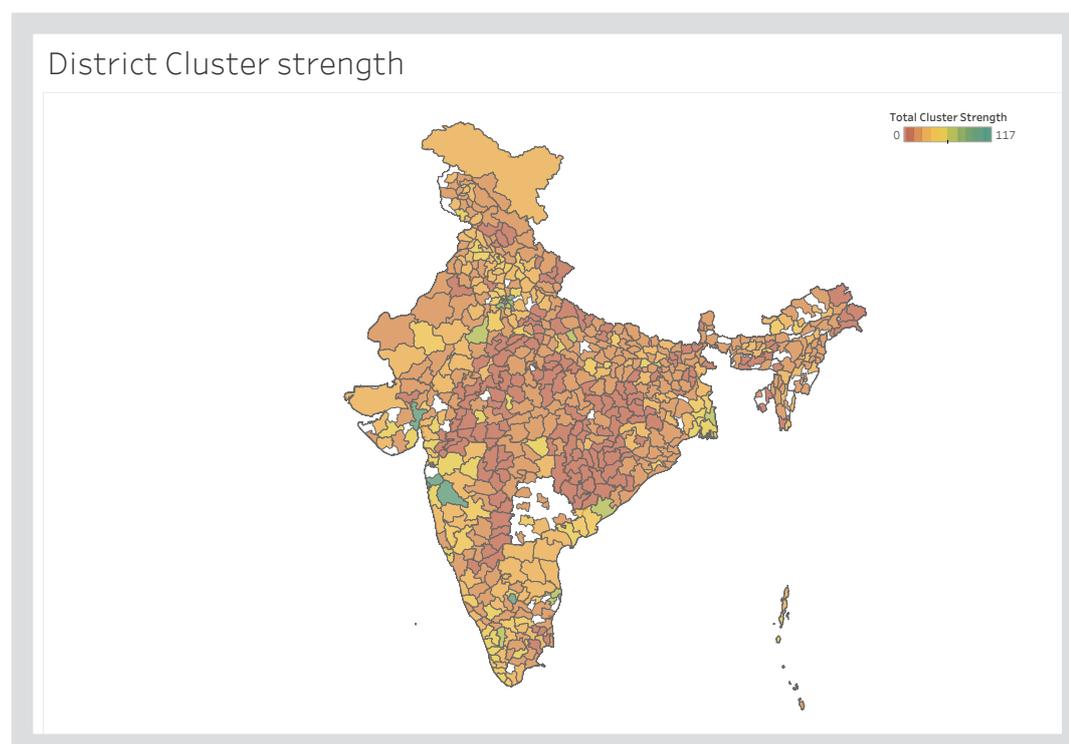
The middle and the bottom districts are greatly dominated by the rural sector in terms of employment, whereas the top 70 group has only 26% share of rural workers. The few rural-dominated districts in the prosperous group, like Palwal in Haryana, Muktsar in Punjab have significant concentrations of agriculture activities. It has 3 times or more higher average wage than the national average wage of the agriculture cluster. In such regions, it is the agriculture which is considered the one of the prime clusters fuelling the local economy's growth. In both middle and bottom group of districts, agriculture and local clusters drive the employment in each sector. However, average wage of agriculture or local clusters are significantly low to drive up the local economy, especially in the rural regions.

There are significant differences in the specialization pattern of the three groups. The prosperous group of districts have large number of strong traded clusters, supporting the hypothesis that strong traded clusters and strong economic performance have a strong causal relationship.

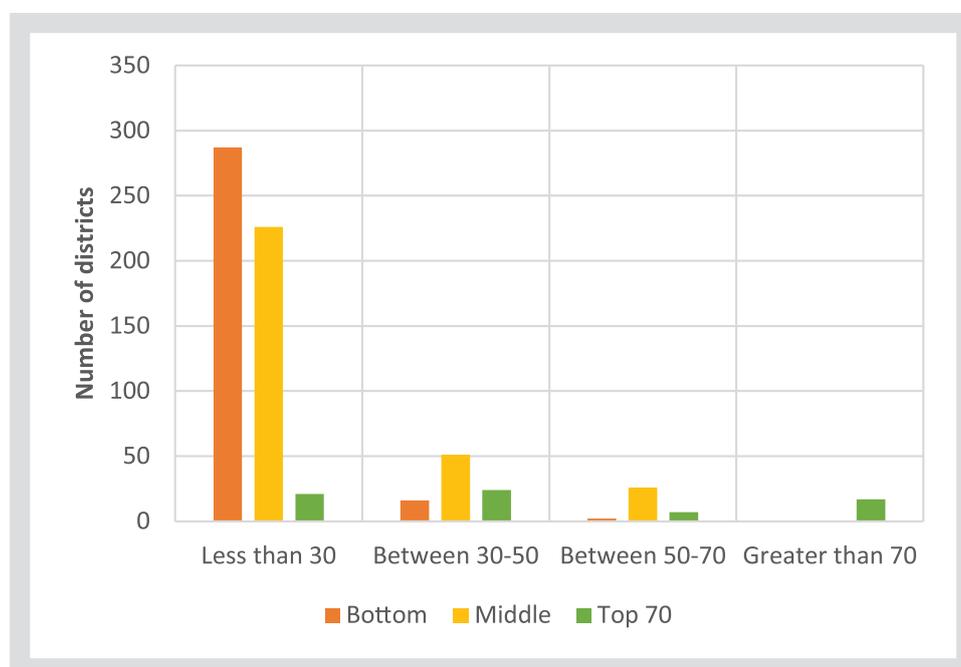


Cluster Strength

To measure the cluster strength at the district level same methodology was used as for the state level. The graph below highlights the hotspot of the country at the district level.



The district cluster strength has a large range of 0 to 117, again, highlighting the large diversity at the granular regional level. The prosperous districts like Mumbai Suburban, North-west Delhi and Bangalore have cluster strength greater than 100, while the poorer districts like Dindori, Guna of Madhya Pradesh and Bijapur of Chhattisgarh have cluster strength of 2. Broadly, many districts belonging to the bottom and middle groups has cluster strength of less than 30, whereas districts with greater strength than 70 belong to the top 70 group. The composition of cluster strength also differs across categories of districts, which can be seen in the graph.



The cluster strength of less and middle-prosperous districts is majorly driven by two-star and one-star clusters. On the other hand, the most prosperous group, in addition to two-star and one-star clusters, have a significant concentration of three-star clusters. It is indicative of the strong business environment in the region which support and promote the growth of variety of cluster. A closer look at the degree of spread across clusters at distinct regions asserts that the high GDP growth states and the districts belonging to the top 70 and middle have a presence of diverse and deep clusters. They are ahead in the race of 3 measure: size, productivity, and LQ. They significantly contribute to the strong clusters as well as to the 3 and 2 star-strength.

Thus, clusters and business environment must be seen as the additional lens to view the regional economies and to understand why and how they differ.

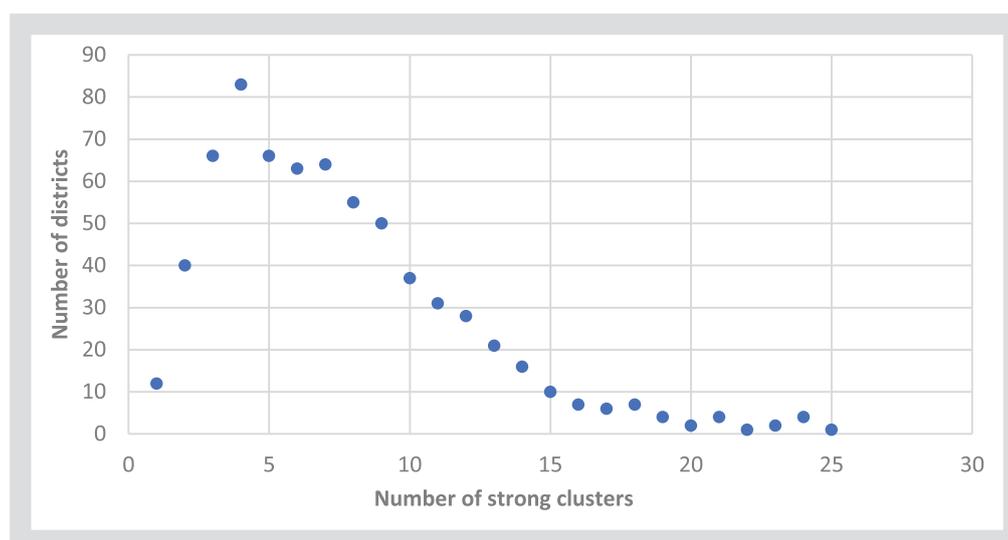
Strong Clusters:

One of the other approaches to examining the economic geography of clusters is by analyzing the distribution of leading clusters. These leading clusters refer to regional clusters that fall within the top 20% of locations in terms of employment specialization within their specific cluster category. The dynamics of clusters are significantly driven by the critical mass of workers in a specific region, which forms a strong cluster. They have a crucial role in improving regional prosperity. The strong and positive relationship between employment in strong clusters and the economic performance of the regions is well established in quantitative studies across many countries. On average, about one-third of the difference in GDP per capita among regions can be explained by differences in the strength of cluster specialization in Europe and North America (**European Commission, 2008**), (**Porter M. E., 2012**). Empirical studies also show that strong clusters usually account for 40%-70% of all employment and payroll in a given cluster category (**Ketels C. , 2017**). To identify strong clusters in our dataset, we adhere to Delgado (2016)

methodology. The top 20% of regions by location quotient within each cluster category is recognized as the strong cluster.

In the top 70 category, the share of employment and payroll in the strong clusters is about 55% and 60%, which is 14 and 27 percentage points greater than the bottom category. It highlights the tendency for more prosperous regions to have major share of their employment and payroll in strong clusters. This is because the businesses in the strong clusters are in the favourable position to convert business environment advantages into competitive advantages (Ketels C. H., 2008). Thus, strong clusters can be another way to look at the economic geography of clusters and understand the heterogeneity among the regions.

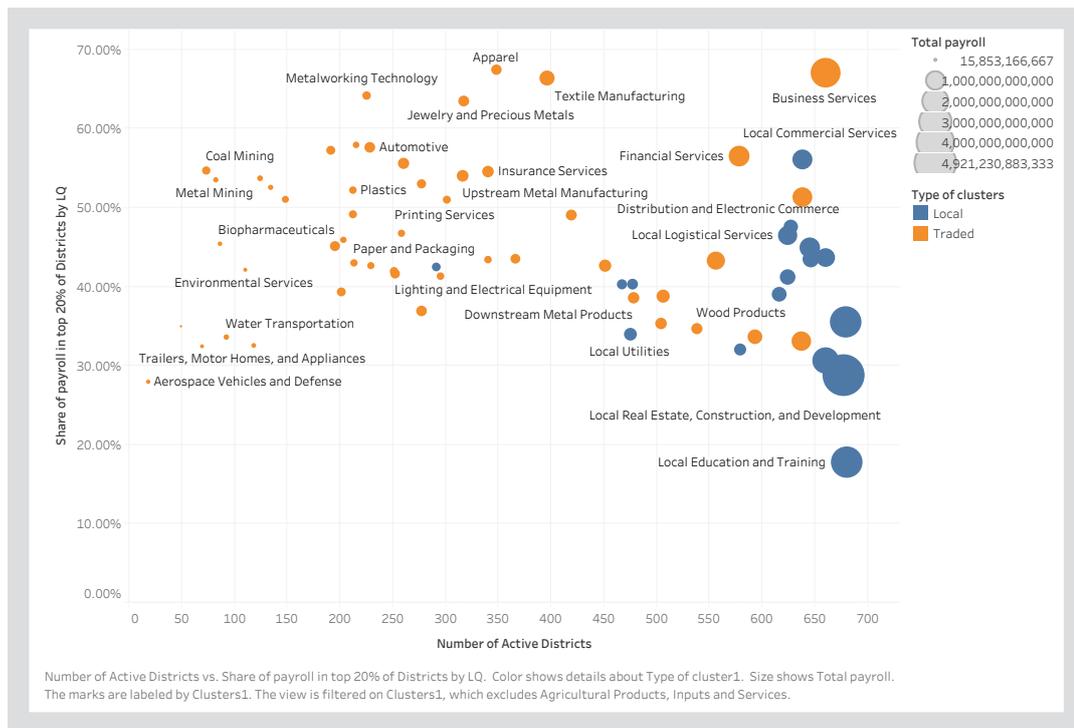
The overall strong clusters account for 16%-72% and 17% to 67% of all employment and payroll, respectively in the various cluster categories. Mostly local clusters are found in the lower end of the range. The distribution of districts by number of strong clusters is highly loop-sided: Many districts have a small number of strong clusters, while a few districts have a large number of strong clusters, as depicted in the graph below. It indicates the high concentration of economic activities in certain geographical regions. Only 181 districts have more than 10 strong clusters, accounting for 29.35% of employment and 47.17% of payroll of strong clusters. These are mostly the districts which have high employed workers or high average wages, mainly concentrated in the urban parts. This suggest that the heterogeneity among the districts in term of their economic performances can be understood by the concentration of strong clusters in the regions.



Traded clusters are usually characterized by their tendency to concentrate activities in a smaller number of regions. In India, this geographic concentration reveals itself in many different categories: Number of cluster categories which have active employment in relatively smaller number of districts: “IT and Analytical Instruments”, for example, is present in only 191 out of India’s 680 districts covered in the data, and the top 20% districts by LQ account for 57.3% of its national payroll. Other clusters belonging to the same category are Metalworking Technology, Coal Mining, Metal Mining, Footwear. They are present in less than 230 districts, but their top 20% districts by LQ account for more than 50% of their national payroll.

Another group of clusters are present in many locations but most of their payroll generation is concentrated in the locations with the highest employment specialization (top 20% districts by LQ). In Business Services, Distribution and Electronic Commerce, Apparel, for example, 67.1% , 51.8% and 67.6 % of the national payroll is registered in the top 20% districts by specialization, respectively.

A third group of clusters is more dispersed across the country like Food Processing, Transportation and Logistics, Wood Products, and Furniture. These large cluster categories are present in more than 500 districts, however, top districts by specialization are less dominant in terms of payroll, contributing only about 40%.

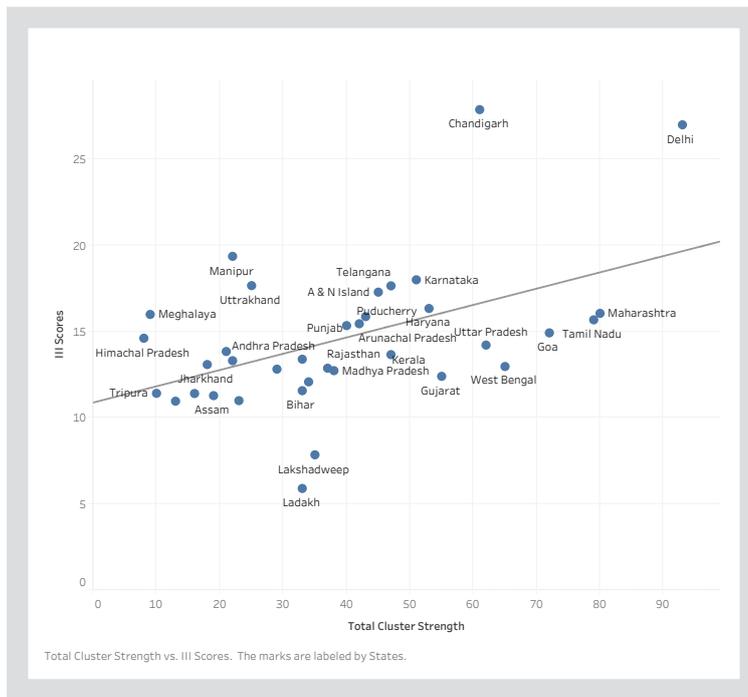


Cluster and Economic Development

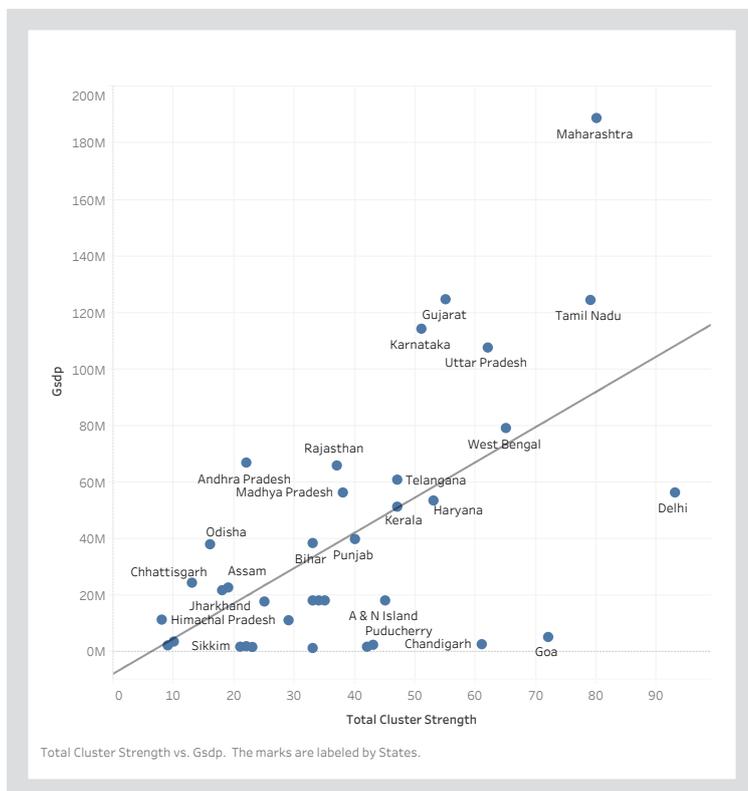
It is a common notion in economic development theories that regions that support diverse economies will be advantageous (**Porter M. E., 2012**). Regions having high cluster strength have presence of large range of cluster types. In addition, the strong linkages and spillovers among them have an unambiguous positive effect on the growth of region. As a result, clusters play a crucial role in a improving the region's ongoing capability to innovate, export, thereby leading to better standard of living and economic growth of the region.

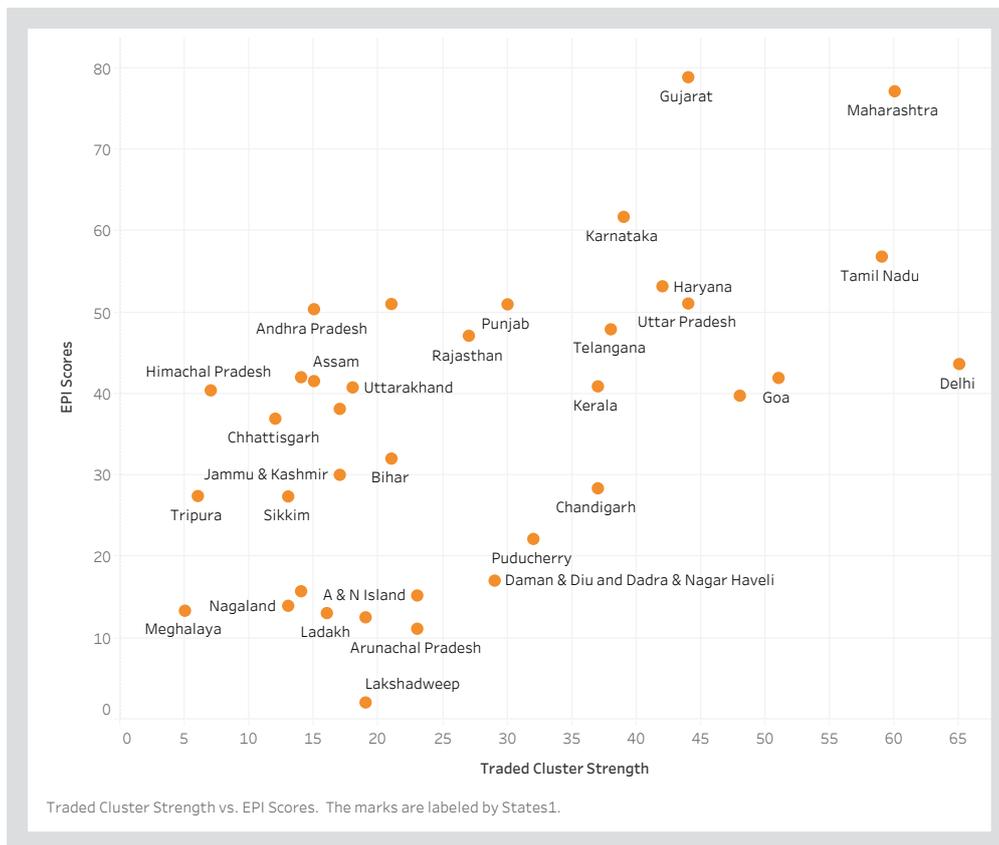
Regions with a strong cluster strength are innovative leaders, while regions with weak cluster portfolios fall behind (Sölvell, 2009).

By providing an environment conducive to research and knowledge creation, clusters play a significant role in a firm's and region's ability to innovate and improve its productivity growth over time. It has been empirically proved across various types of economies, and the same trend has been observed in India. There is a positive correlation between the innovation scores 2021 and the cluster strength of the states. It suggests that in India, innovation is also heavily geographically concentrated with respect to the overall regional cluster performance, with few exceptions.

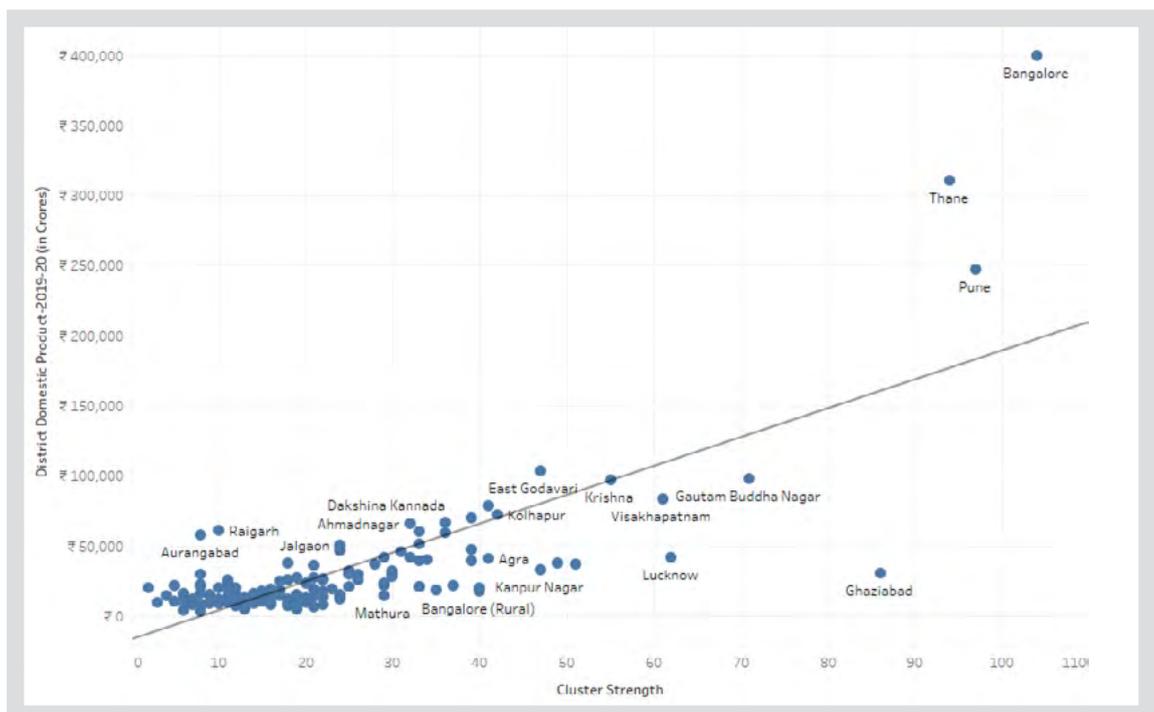


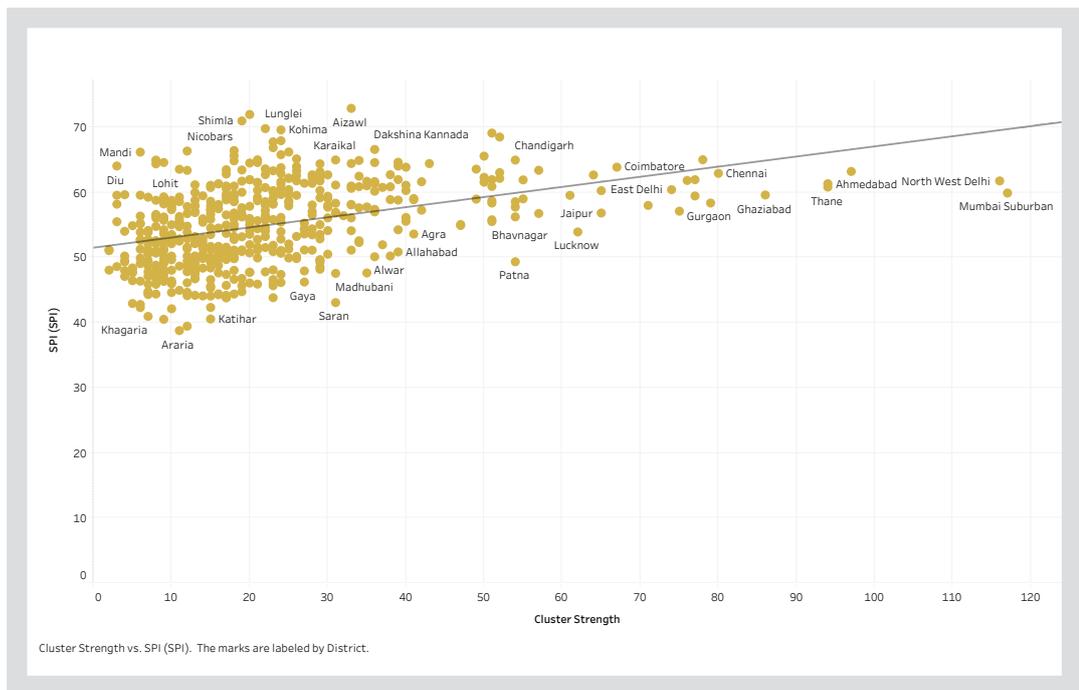
In addition to innovation, many other key economic parameters like export performance, Gross Domestic Product (GDP) tend to be positively correlated to cluster strength. Clusters, mainly traded ones, are the driving force for expanding exports, as they serve broader markets and can grow employment and exports well beyond local needs (Porter M. E., 2007) The traded cluster strength of the states is positively related to the Export Preparedness Index scores (2021). A similar positive relationship exists between the GDP, and GDP per capita with cluster strength. The results are in sync with the literature and further confirming the established link between cluster strength and other economic variables.





The same is true for the variables at the district level. Plotting the available Gross Domestic Product of the districts against their calculated cluster strength showed the positive association, confirming the strong relationship between clusters strength and economic growth even at the granular geographical level. In addition to the economic performance of the region, cluster strength is positively correlated to the social progress of the region too, as depicted in the below graph.





While we have observed a positive correlation between cluster strength and various factors such as GDP, social progress, innovation, and exports, it's important to recognize that correlation does not necessarily imply causation. Other factors not considered in the analysis could be influencing these relationships. To gain a deeper understanding of the relationships between cluster strength and these factors, a more sophisticated analysis would be required. This could involve more appropriate data collection, employing advanced statistical techniques, controlling for confounding variables, and conducting rigorous research to determine the causal pathways at play. Such an approach would help uncover the underlying mechanisms and shed light on the complex dynamics between these variables.

India's cluster leaders

The Indian economy at the sub-regional level is dominated by variety of traded and local clusters, where only few of the regions are specialized. The table presented showcases the top 20 districts in India that boast leading clusters, distinguished by their impressive cluster strength and substantial share of payroll originating from strong clusters. Out of the 680 districts in the country, only 28 manage to achieve a cluster strength greater than 50 and predominantly draw their payroll from strong clusters. Notably, most of these exceptional regions belong to the prosperous group of top 70 districts, signifying their crucial role in India's economic performance.

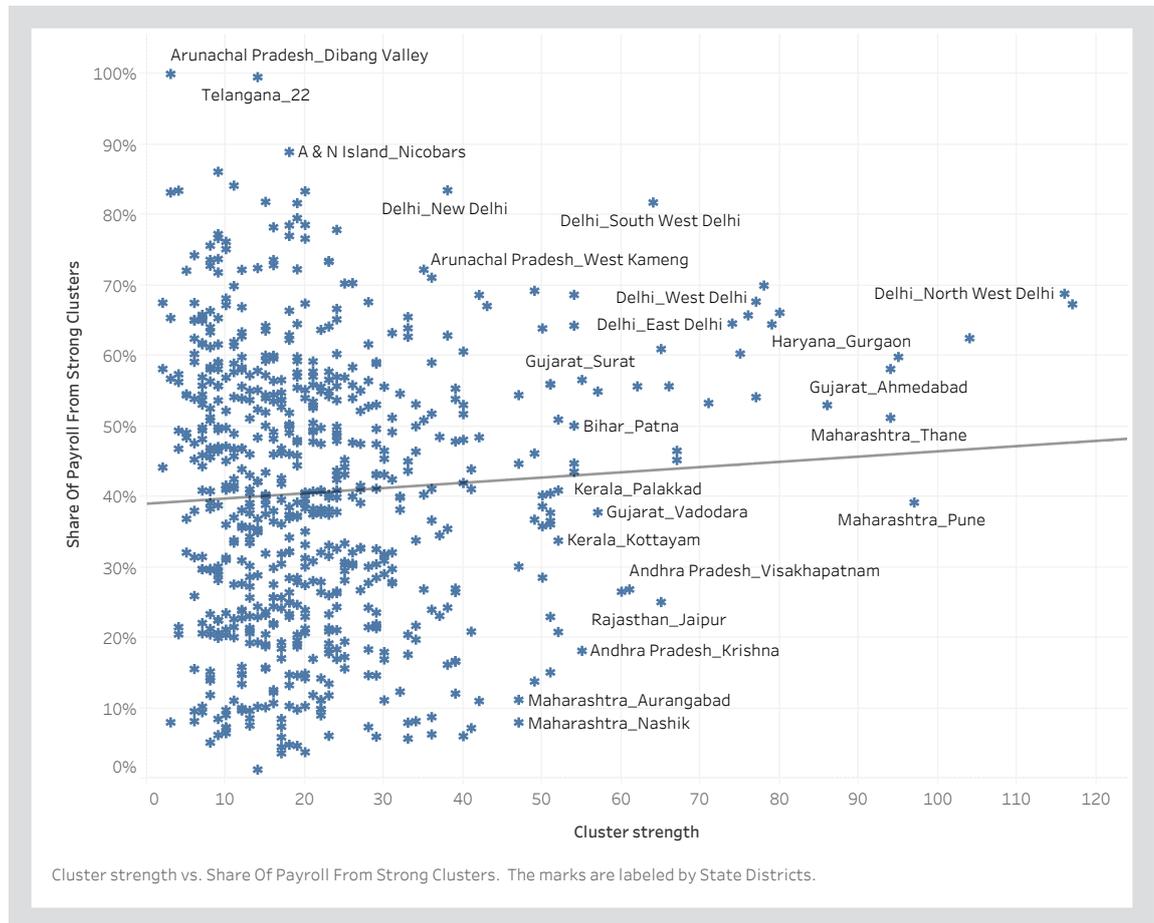
State	Districts	Categorization of Districts	Cluster strength	share of payroll from strong clusters
Maharashtra	Mumbai Suburban	Top 70	117	67%
Delhi	North West Delhi	Top 70	116	69%
Karnataka	Bangalore	Top 70	104	63%
Gujarat	Ahmedabad	Top 70	94	58%
Maharashtra	Thane	Top 70	94	51%
Uttar Pradesh	Ghaziabad	Top 70	86	53%
Tamil Nadu	Chennai	Top 70	80	66%
Haryana	Gurgaon	Top 70	79	64%
Delhi	South Delhi	Top 70	78	70%
West Bengal	Kolkata	Top 70	77	68%
Telangana	Hyderabad	Top 70	77	54%
Delhi	West Delhi	Top 70	76	66%
Delhi	North East Delhi	Top 70	75	60%
Delhi	East Delhi	Top 70	74	65%
Uttar Pradesh	Gautam Buddha Nagar	Top 70	71	53%
Tamil Nadu	Kancheepuram	Middle	66	56%
Haryana	Faridabad	Top 70	65	61%
Delhi	South West Delhi	Top 70	64	82%
Uttar Pradesh	Lucknow	Middle	62	56%
Kerala	Ernakulam	Middle	57	55%
Gujarat	Surat	Middle	55	57%
Chandigarh	Chandigarh	Top 70	54	69%
Kerala	Thiruvananthapuram	Top 70	54	64%
Bihar	Patna	Middle	54	50%
Goa	North Goa	Top 70	52	51%
Goa	South Goa	Top 70	51	56%
Assam	Kamrup Metropolitan	Top 70	51	56%

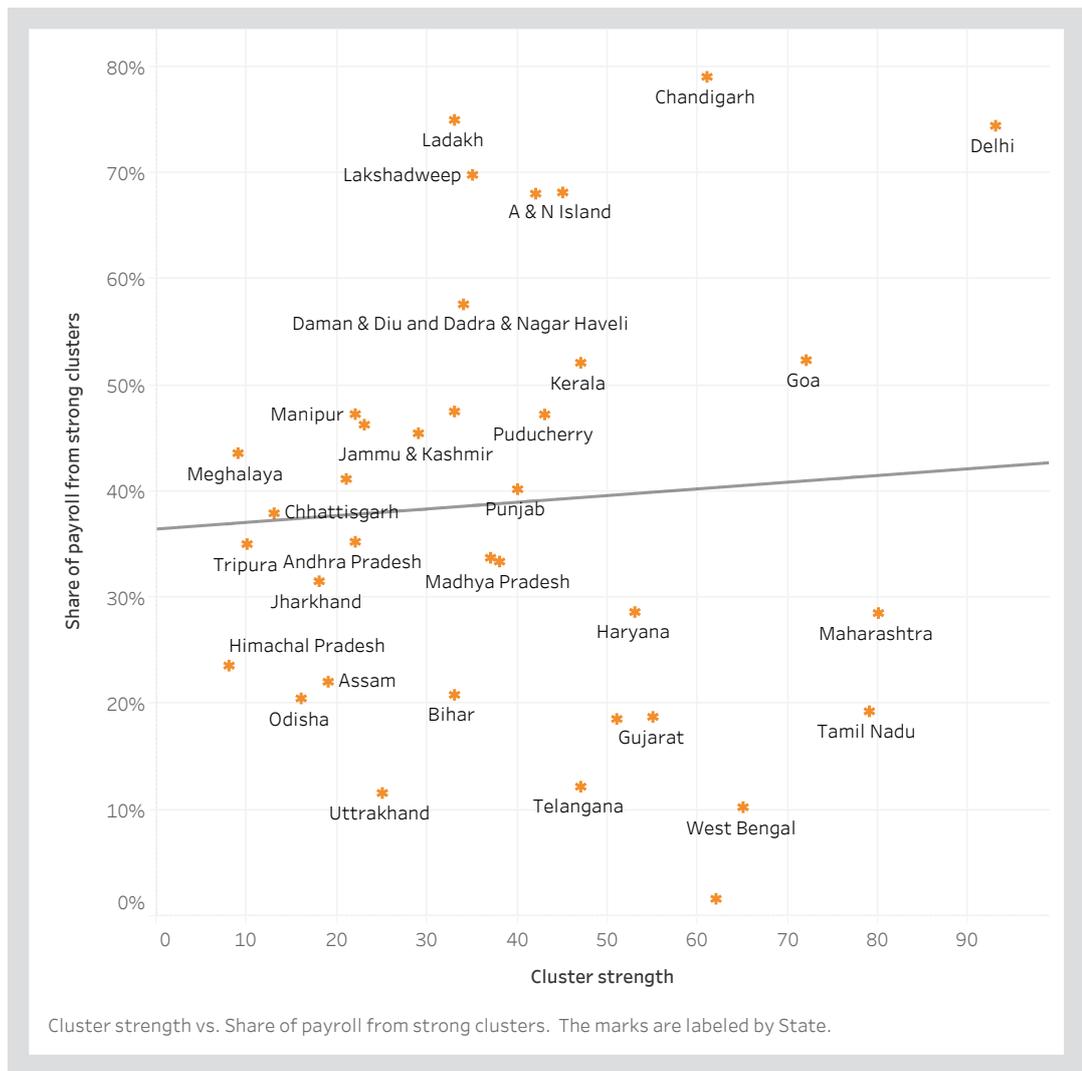
At the state levels, larger regions like Maharashtra, Karnataka, and Uttar Pradesh with high cluster strength show surprisingly low levels of payroll share from strong clusters, hinting at potential disparities in economic concentration within these states.

State	Cluster strength	Share of payroll from strong clusters
Delhi	93	74.44%
Maharashtra	80	28.56%
Tamil Nadu	79	19.31%
Goa	72	52.37%
West Bengal	65	10.28%
Uttar Pradesh	62	1.66%
Chandigarh	61	79.04%
Gujarat	55	18.79%
Haryana	53	28.66%
Karnataka	51	18.59%
Kerala	47	52.13%
Telangana	47	12.22%
A & N Island	45	68.16%
Puducherry	43	47.26%
Arunachal Pradesh	42	68.05%
Punjab	40	40.22%

The table shows the States/ UTs with a cluster strength greater than 40.

At the both the levels, state and district level, a weak but positive correlation is observed between cluster strength and the share of payroll from strong clusters, suggesting that highly competitive and specialized economic activities concentrate in the relatively smaller geographical areas. Such a relationship is more evident at the state level, as different regions exhibit more diverse patterns of economic specialization and payroll contribution from strong clusters. Interestingly, smaller geographical areas tend to exhibit a greater share of payroll from strong clusters, indicating the significance of concentrated economic activities in smaller districts.





Overall, this data provides valuable insights into the leading districts with strong clusters in India and underscores the importance of district-level analysis to comprehend the dynamics of cluster strength and payroll distribution.

Conclusion

Emphasis on clusters as a primary feature of regional and national economies is growing among academic researchers, and policymakers as it significantly influences productivity, innovation, competitiveness and economic performance. The global landscape of clusters is also changing over time, as the cluster's geographic location and activity profiles are constantly adjusting to globalization. The connection between clusters and modern competition has important implications for the economic geography of regions at every level: cities, districts, states and countries. Economic geography provides a framework for understanding the conditions that lead to the formation and success of clusters, while the concept of clusters provides a framework for understanding the dynamics of economic activity within a particular region or industry. Together, they help us to understand the factors that shape the competitiveness of regions and industries and the interactions between the economy and the environment, making clusters conceptually significant within the economic geography.

Using the cluster mapping methodology, the paper provides a comprehensive perspective on the presence of clusters of the country using the Periodic Labour Force Survey dataset to understand the Indian economy at a more location and sector specific level. It presents the image of traded, local and agriculture clusters highlighting their structure and distribution across state and districts regions. It also highlights their role in employment and productivity growth. Each broad category of a cluster has an equally important role in improving the competitiveness and prosperity level, as each contributes significantly to the key dimensions: Employment, Payroll and Productivity at the national level and regional level. When we move from broad categories of clusters to narrower ones, it becomes evident that certain local clusters in India, such as local government, local health services, local utilities, and local education, exhibit noticeable distortions. Specifically, these clusters stand out due to their substantially high average wage levels, which are comparable to those found in traded clusters. The presence of such distortions in these local clusters is significant. It raises questions about the underlying factors driving these higher wages. The observation of these local clusters having wages on par with traded clusters indicates a departure from the expected wage patterns. Traded clusters, typically associated with industries engaged in export-oriented activities or those integrated into global value chains, tend to have higher wages due to factors such as higher productivity, access to international markets, and exposure to global competition.

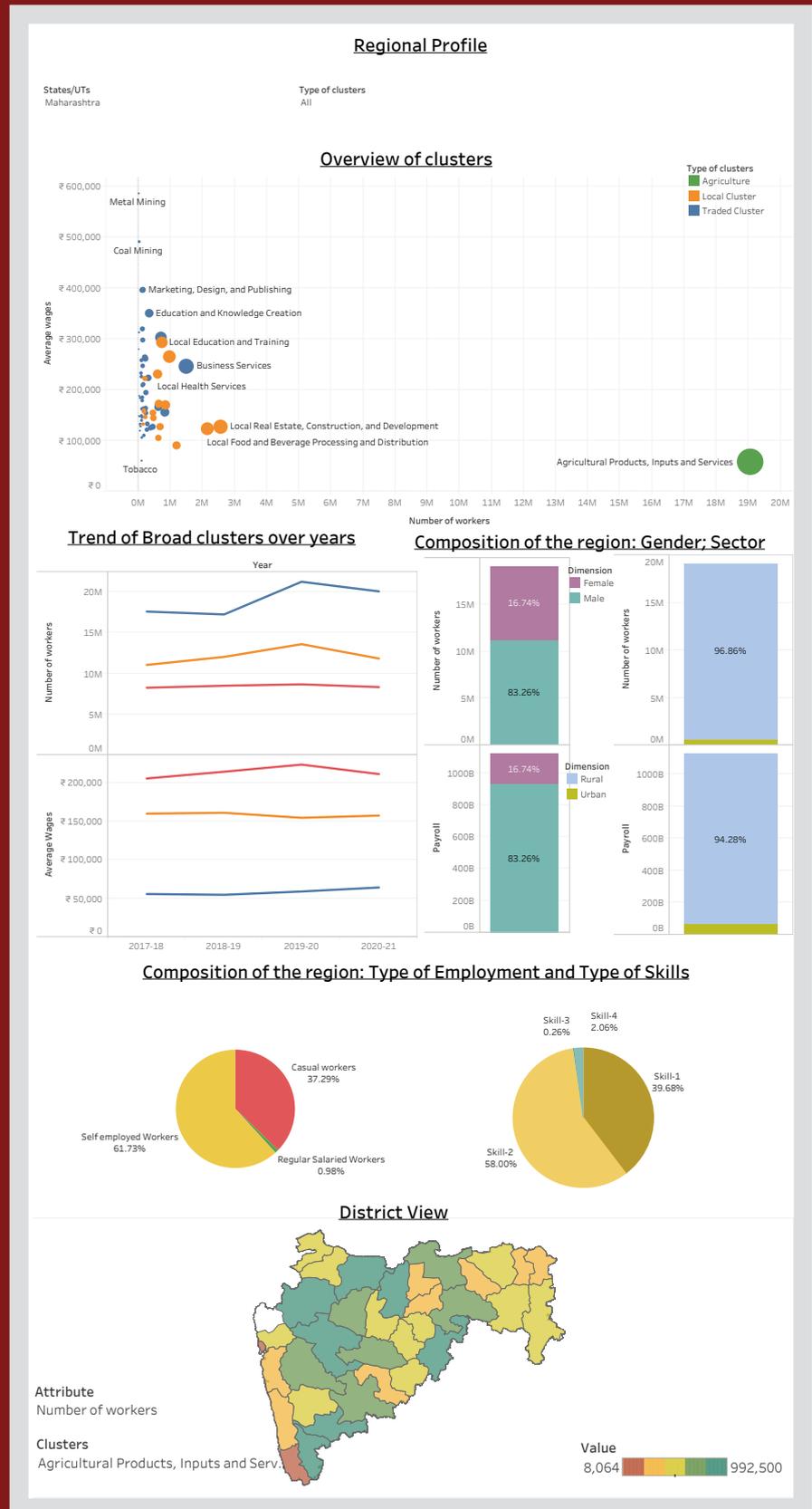
A further detailed study into the economic geography of narrow cluster categories shows varying spatial patterns of traded clusters in India. Some clusters exhibit concentration in a limited number of districts, while others have a more dispersed presence, each having different payroll contribution from its specialized districts (Top 20% of districts by LQ). It also reveals that the huge differences in regional economic performance across India are associated with large differences in cluster portfolio and strengths. The high GDP states and the districts belonging to the Top 70 and the middle group have a presence of diverse and deep clusters, which is reflected by the high number of three-star clusters and the total cluster strength of the regions. The crucial economic outcomes of the region, like Gross Domestic Product, innovation and export, are observed to be positively related to the cluster strength, confirming the theoretical literature.

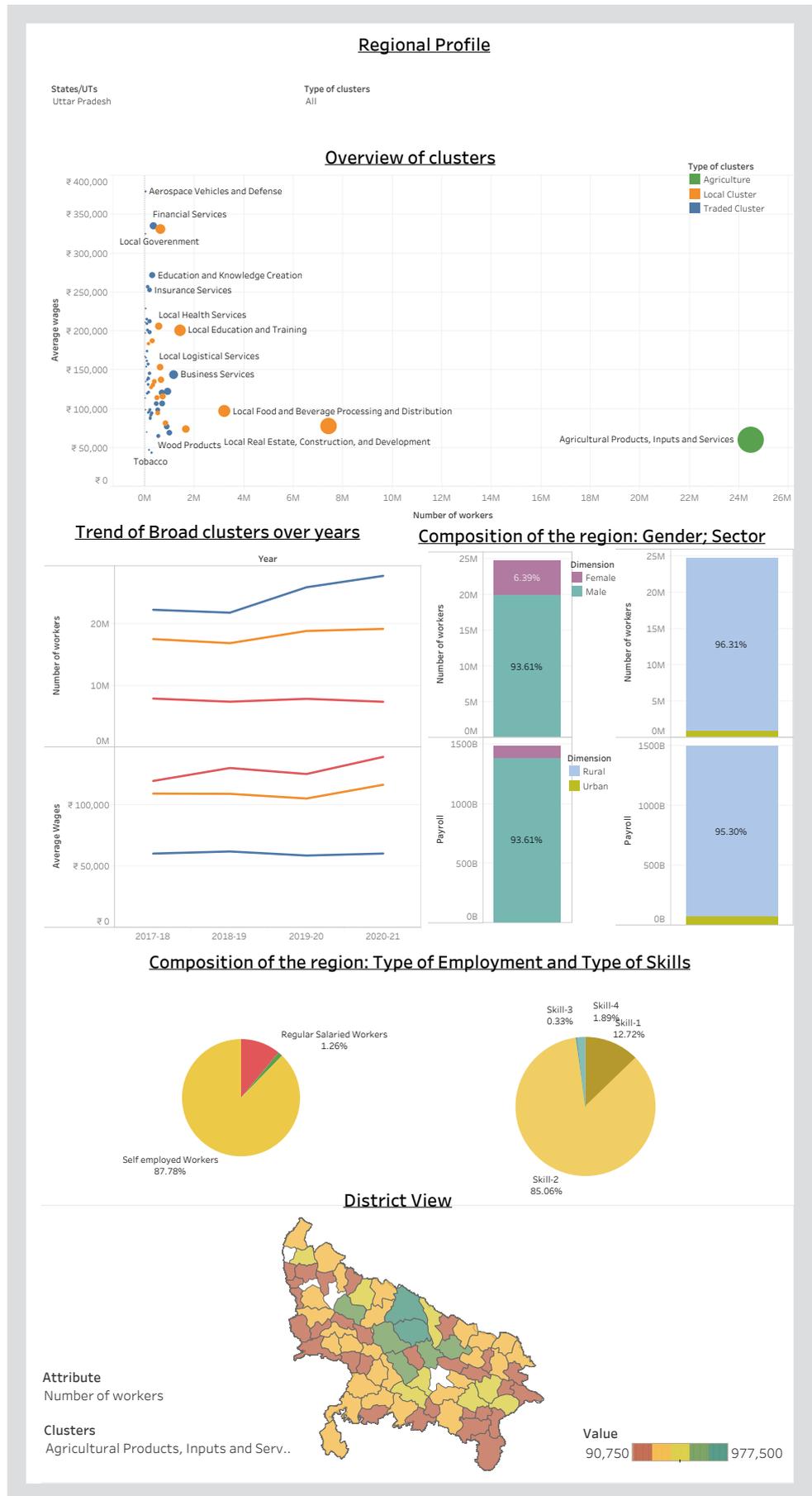
Analysing clusters can also help us understand the dynamics of economic activities at a more granular level, with special focus on the key dimensions like gender, sector, skill and occupational patterns. It can provide insights into where the entry barriers might be lower, enabling policymakers and researchers to formulate targeted strategies and policies. Understanding these patterns is crucial for promoting inclusivity, gender equality, and creating opportunities in both rural and urban areas for all types of skill workers.

Evidence-based policymaking is the need of the hour, and cluster initiative is one of the roads leading to it. It lays an important foundation as the cluster approach leverages the natural existence of clusters in different regions and aims to better channel government policies while promoting collaboration among public and private sector entities. The adoption of a cluster-based approach promotes specialization, collaboration, and value creation within sectors, optimizing resource allocation and encouraging innovation. Consequently, the implementation of cluster mapping in India holds great potential as the next steps in economic development. India can use cluster mapping data to make informed policy decisions at the national and regional levels. By doing so, it can understand the spatial distribution and dynamics of its clusters, and develop a cluster-based economic development approach, tailoring strategies to the unique strengths and opportunities of different clusters. Regular statistical reporting that includes the cluster dimension can enhance the understanding of regional and sectoral dynamics, facilitating evidence-based decision-making and monitoring of cluster development initiatives. These steps will help India optimize resource allocation, foster innovation, and drive inclusive and sustainable economic growth. By looking at the examples set by other developed countries like the United States and Sweden, India can unlock the full potential of its clusters and propel its economy towards greater competitiveness and prosperity.

Appendix I Profiles

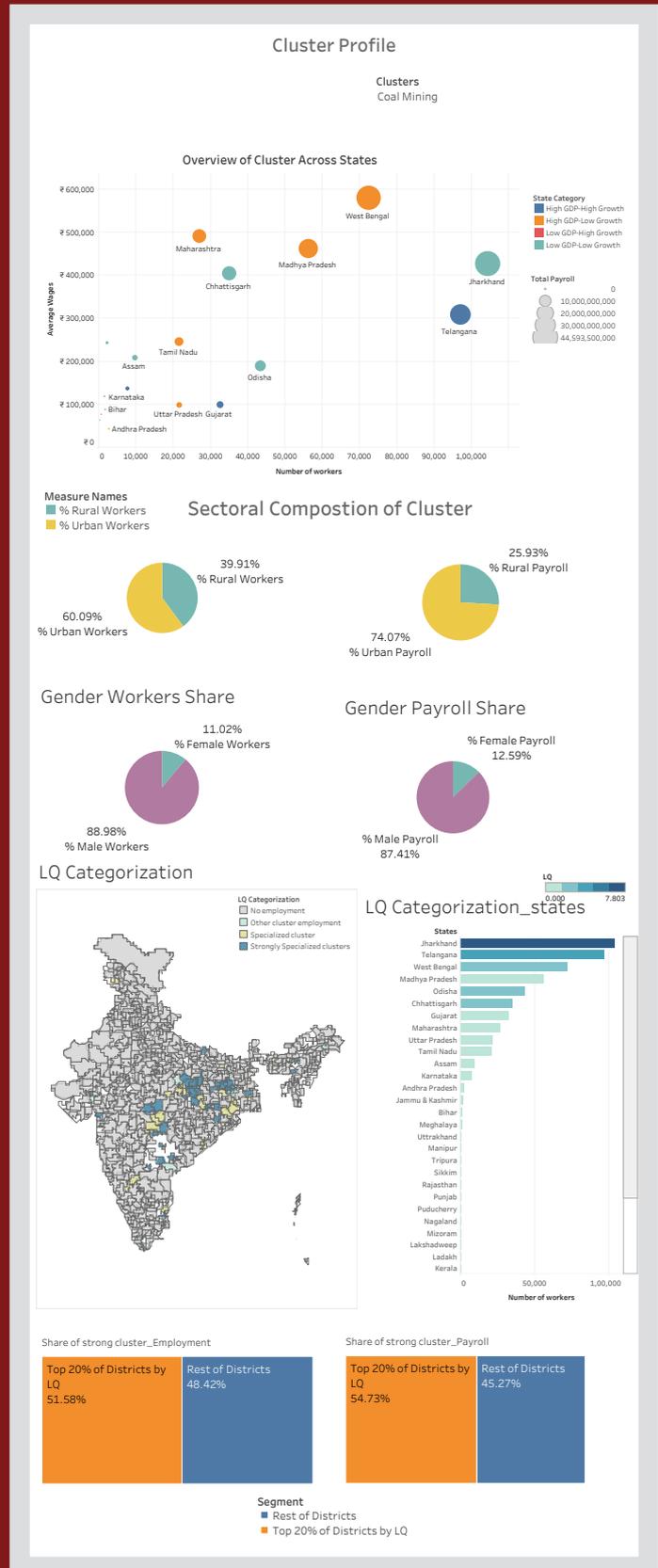
State Profiles: MAHARASHTRA



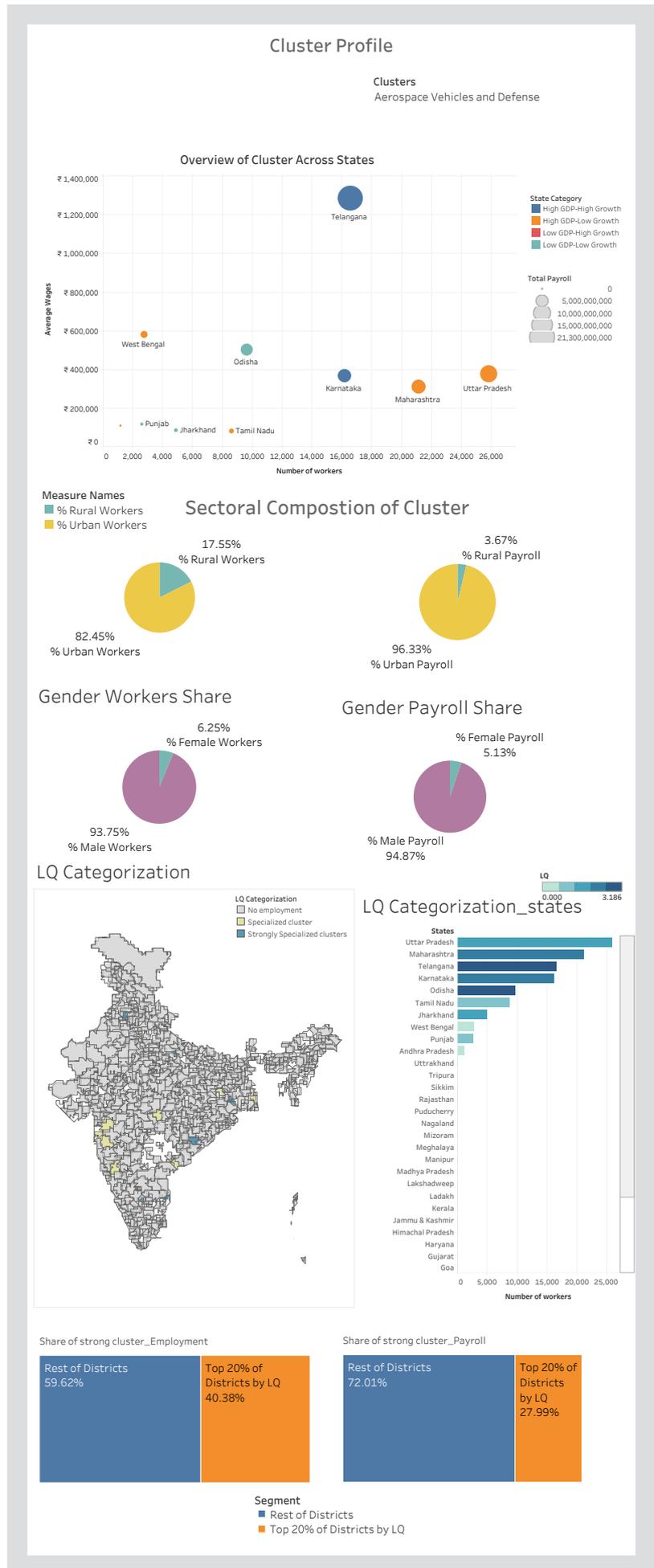


Cluster Profiles

COAL MINING



AEROSPACE VEHICLES AND DEFENCE



Implication for Research and Policy Making

Clusters have come under the consideration of policymakers in recent years. The potential held by clusters as a microeconomic driver of the economy is critical to reaching any economic and social goal. Looking at the economy through a cluster lens can highlight the development opportunities and unique insights each cluster portfolio holds, which are valuable and essential in developing cluster-based policies. There are several areas where policy intervention can help clusters progress. Some of them are collaboration and strengthening linkages between firms within or among the different clusters, lowering transaction costs and barriers to entry, and initiating skill development programs (**Ketels C. , 2017**).

A tool to access and measure the unique cluster characteristics is necessary to design distinct cluster policies and initiatives. Cluster mapping becomes the next step to understanding the cluster portfolio of a region. Cluster-related policies have gained the interest of many policymakers, and there is an emerging consensus on the usefulness of clusters as an analytical tool for policymakers around the globe.

In addition, there is a wave of a paradigm shift in policymaking: from a macroeconomic focus to a microeconomic. Macroeconomic policies like monetary and fiscal are well acknowledged and used in everyday planning. However, it is insufficient if the goal is to improve the overall prosperity levels of the economy. Planning and targeted microeconomic efforts are required to translate macroeconomic achievements into real productivity improvements among micro-players like firms and businesses. How a company survives and operates in a particular region is highly influenced by the microeconomic circumstances of that location, forming its business environment. Clusters enable companies to be more innovative and productive than they would have been in isolation. As a consequence, cluster-related policies are being favoured by private sector leaders.

Government policies and the existing economic capabilities in a region highly affect the likelihood of cluster emergence. Government policies, directly and indirectly, influence numerous aspects of the business environment, like environmental and labour market regulations, infrastructure, and others. They also play an active role in making the market attractive to entrepreneurs by lowering barriers to entry and facilitating collaboration among players in the market. In addition to modifying its practices and policies, the government can motivate, facilitate, and give incentives to the private sector. By focusing on the cluster as a policy tool, the government can pay better attention to areas where it can simultaneously increase several companies' competitiveness. Furthermore, it can reap additional gains from the spillover of the cluster triggered by the policy focus (**Ketel & Memedovic, 2008**).

Leaders of private businesses, government, educational and research institutions have a role to play in the new economics of location and competition, which is based on mutual dependence and collective responsibility. The experience around the world suggests

that public-private partnerships are the most successful cluster initiatives. It is used as a platform for a better dialogue between the private and the public sector to improve the cluster-specific business environment in a region. Therefore, the opportunity to redefine the roles of the public and private sectors in economic policy and growth can be viewed in the context of cluster efforts.

Apart from focusing on macroeconomic policies imposed across the country, governments also focus on industry-level policymaking. One cannot substitute cluster-based policy for an industrial policy, as their foundation and implications are fundamentally different. The industrial policy rests on a view of competition in which few industries offer higher wealth-creating prospects than others (**Porter M. E., 2000**). Industrial policies provide targeted support to such industries. Policies are formulated considering the competitive outcomes anticipated to be in the nation's favour. Importance is given to high-priority emerging industries through subsidies, selective import protection, restrictions on foreign investments, etc., to increase their returns to scale. However, setting policies to benefit individual firms leads to market distortions and inefficient use of government resources.

Cluster policies, on the other hand, are based on healthy competition and cooperation among firms and locations through productivity growth instead of only bolstering individual firms. Economic development through cluster-based policies strengthens the competitiveness fundamentals of clusters, and they cater to all the clusters rather than just the emerging ones. The cluster theory, unlike industrial policies, appreciates imports and foreign firms entering the market. It advocates that foreign firms enhance the clusters' externalities and competition, thereby increasing productivity and employment generation (**Porter M. E., 2000**). Also, emphasizing policies focused on improving the business environment in clusters will return high benefits to the overall upgradation of the cluster and the spillover effect on the regions with that particular cluster.

"All clusters can be desirable, and all offer the potential to contribute to prosperity. What matters is not what a nation (location) competes in but rather how it does so."
Michael Porter

Cluster theory, all in all, supports the idea of removing obstacles, relaxing constraints, and eliminating inefficiencies to induce growth and productivity instead of providing subsidies and protecting from imports. Following the US, many developed and developing countries like the UK, Netherlands, Denmark, Sweden, Ireland, and other European countries have adopted the cluster approach. They view their economic policies as providing significant cluster development budgets and improving regional and national competitiveness. The heterogeneity of the regions is extensive and cannot be covered under one model to fit all. Hence, when made with a cluster-based perspective, policies are versatile and mindful of all the underlying factors that can elevate a cluster or region in the competitive world.

Cluster Initiatives in Other Countries

Knowledge about cluster theory has advanced over time and spread worldwide. Despite vast theoretical literature, empirical studies of the same have been comparatively limited. Few countries like the US, Sweden and others in European Union have successfully applied the cluster theory in practice through various cluster initiatives over the years. Most analyses of such cluster initiatives are based on selected case studies, which are well documented in Cluster Initiative Greenbook or the region's clusters report.

Cluster mapping is an initiative that primarily aims to identify clusters in specific geographical locations and analyze the factors that contribute to and strengthen their presence. Countries, which are mostly developed, have used the initiative as a tool to recognize the critical clusters in smaller regions like states, counties or cities. By identifying key clusters, policymakers and other relevant stakeholders were able to better understand the local economy's strengths and weaknesses and develop targeted policies to support the growth of these clusters and the region.

The cluster mapping initiative in the United States is led by the Harvard Business School Institute for Strategy and Competitiveness, in partnership with the U.S. Economic Development Administration (EDA) and other organizations. Over the years, it has been used to inform policy decisions at all levels: federal, state, and local levels. At the federal level, the EDA uses the data and insights from the initiative to inform its programs and funding decisions, while at the state and local levels, the data and insights from the initiative are used to inform economic development strategies and target resources to support specific industries and regions. Presently, it is being used at the city level to identify critical clusters and assesses its regional environment. It highlights the accomplishments, lessons learned, challenges, and opportunities of various clusters present in the region.

In addition to its role in informing policy decisions, the cluster has also played an important role in promoting regional economic development and competitiveness. The growth strategies based on stronger regional clusters of innovation have been supported through funding from the Economic Development Administration, the Small Business Administration (SBA), the Department of Labour, the Department of Education, the Department of Energy and others.

European Union has also been actively promoting the use of cluster mapping through several initiatives and funding programs. Support for clusters has been a mainstay of most national and regional competitiveness programmes for the past thirty years, and cluster organizations are now operating in practically all of Europe. The European Cluster Observatory (ECO) is one of the main platforms that aim to support cluster development and policymaking through the collection, analysis and dissemination of data. Another platform working in the same direction is the European Cluster Collaboration Platform (ECCP), a project funded by the European Union with the aim of promoting the competitiveness and innovation of European businesses by fostering collaboration among clusters. ECCP supports cross-border collaboration among businesses, research institutions, and clusters, with a focus on small and medium-sized enterprises (SMEs). It provides a range of services and tools to facilitate cluster-to-cluster

cooperation, including matchmaking events, online platforms, and training programs. In addition, to enhance the innovation and competitiveness of the firms and the regions, it has also played a significant role in fostering resilient, green and digital industrial ecosystems in recent times. As a result of the transversal nature of greening and digitalization across all industries and industrial ecosystems, over 80% of cluster organizations in the EU-27 support businesses in their digital transformation and over 60% in their green transition (**Knight, 2021**).

Sweden and Catalonia are among the first few economies where the cluster program was replicated. The Swedish Cluster Mapping Project, which is a joint initiative between the Swedish government and several universities and research institutes, has mapped over 300 clusters in the country and identified key clusters in areas such as advanced engineering, biotech, and creative industries. Vinnova, another Swedish government agency for innovation, uses cluster analysis to identify and support strategic innovation areas. Some other examples of cluster initiatives include the Swedish Life Science Cluster, the Swedish Cleantech Cluster, and the Swedish ICT Cluster. All such initiatives receive support from the Swedish government and the European Union. Clusters have also been used to inform regional development policy and to identify the potential for growth in less developed regions. This includes providing funding and support to clusters in these regions to help them develop and grow. This approach recognizes that clusters are not only found in urban areas but also in rural and peripheral regions and that these clusters can be important drivers of economic growth (**Ketels C., 2009**).

Like Sweden, the Catalonia government also provides support to specific crucial clusters through different initiatives. Catalonia's Industrial Technological Plan⁶ has been developed with the help of the government to promote the competitiveness of Catalonia's industry, with a special focus on clusters of advanced manufacturing, such as the aerospace and automotive clusters. Another example of government support is the Cluster of Health and Life Sciences of Catalonia (CSISC)⁷, which is a public-private partnership that promotes the competitiveness of the health and life sciences sector in Catalonia. About 30 clusters in the Catalonia Clusters Programme, which comprises of about 2600 firms, generates 30% of the region's GDP.⁸

Such examples across the globe help us understand the vast potential of clusters in improving the competitiveness of the firms and region, thereby enhancing the economic growth.

⁶ <https://catalonia.com/key-industries-technologies/technologies>

⁷ <https://catalonia.com/key-industries-technologies/health-life-sciences>

⁸ <https://clustercollaboration.eu/news/catalan-clusters-mobilized-against-covid-19>

Clusters in India

Cluster development has been widely recognized as one of the key strategies in India to enhance competitiveness and promote economic growth, particularly in the context of the country's industrial and manufacturing sectors. In India, a cluster is understood as the concentration of firms producing the same or similar products/strategic services in a common geographical area⁹.

India has a long history of traditional artisanal clusters such as the Banarasi saree cluster in Uttar Pradesh and the Kancheepuram silk saree cluster in Tamil Nadu, the Moradabad brassware cluster in Uttar Pradesh, and the Jodhpur handicrafts cluster in Rajasthan. These agglomerations are based around a particular craft or industry, characterized by a high degree of specialization and skill. These clusters have evolved naturally over time, mostly driven by local entrepreneurial activity and supported by local networks and institutions.

In the last few decades, the country has witnessed the emergence of modern industrial clusters, particularly in the areas of IT and software development. The Software Cluster in Bangalore, for example, is one of the most famous modern clusters in India and is referred to as the Silicon Valley of India. It is home to some of the world's largest software companies like Infosys, Wipro, and Tata Consultancy Services. Another example is the Auto cluster in Pune, which is a hub for the automobile and auto component manufacturing industry in India.

The government recognized the importance of clusters in promoting economic growth and has taken various initiatives to support their development in the past few years. Various policies and programs like Industrial Cluster Development Program and National Manufacturing Competitiveness Program have been established by the Ministry of Micro, Small and Medium Enterprises¹⁰. These programs provide support to most manufacturing firms in various sectors, such as textiles, leather, handicrafts, electronics, and automobiles. Other such initiatives are Horticulture Cluster Development Programme¹¹, Engineering clusters¹², and Science and Technology clusters¹³. They aim to create strong linkages between academic institutions, research laboratories, and other stakeholders like relevant ministries, industry partners, MSMEs, state governments, philanthropic foundations, and international organizations.

The government is also encouraging the formation of clusters through the creation of Special Economic Zones (SEZs)¹⁴, which are designated areas that provide special tax incentives and other benefits to businesses. These SEZs often include clusters of related industries, with the aim of creating a conducive environment for the growth and development of these industries.

Many state governments in India have also launched their own cluster development programs and initiatives, such as Promoting circularity in Tamil Nadu's leather cluster¹⁵ and technology clusters in tier II cities in Karnataka¹⁶.

⁹ <https://www.clusterobservatory.in/clustermap.php>

¹⁰ https://my.msme.gov.in/mymsme/reg/COM_ClusterForm.aspx

¹¹ <https://pib.gov.in/PressReleasePage.aspx?PRID=1723155>

¹² <https://pib.gov.in/Pressreleaseshare.aspx?PRID=1796888>

¹³ <https://www.psa.gov.in/st-clusters>

¹⁴ <https://economictimes.indiatimes.com/news/economy/policy/govt-prepares-a-list-of-10-mega-clusters-across-nine-states-to-attract-global-companies/articleshow/75766815.cms?>

¹⁵ <https://www.thehindu.com/news/national/tamil-nadu/sustainability-project-launched-for-leather-clusters-in-tn/article65553574.ece>

¹⁶ <https://economictimes.indiatimes.com/news/economy/policy/karnataka-plans-to-create-technology-clusters-in-tier-ii-cities/articleshow/84349102.cms?from=mdr>

These programs provide financial and technical assistance to clusters with the aim of improving their productivity, competitiveness, and export potential. They have emerged as an important strategy in India, with the potential to promote growth, innovation, and employment in a variety of industries.

In recent years, there has been a growing emphasis on promoting sustainable cluster development across all the smaller geographical regions of the country and not just a few. The need of the hour is to adopt a global concept of clusters, which is more than the simple agglomerations of the firms in a common region. The strong linkages which are present among the various stakeholders in the market are important to capture and exploit for enhancing the rate of competitiveness and prosperity growth in the country. Consequently, we have used a much broader and inclusive definition of clusters, given by Michel Porter, which is universally accepted and applied by many developed and developing countries.

In 2017, Institute for Competitiveness, India, and Institute for Strategy and Competitiveness laid the foundation for the India Cluster Mapping initiative. It is well documented in the first edition: "Clusters: The Driver of Competitiveness". It explores various clusters present at the state level, using the Annual Survey of Industries (ASI) data. In addition, it presents the empirical results of the relationship between clusters, innovative capacity, competitiveness, and economic performance of the regions. Based on the valuable insights gained through the statistical analysis, recommendations were made to help businesses and regional policymakers to make informed decisions. In addition to that, significant analysis is also undertaken in the Competitiveness Roadmap for India@100, highlighting the heterogeneity and presence of a large number of cluster categories across locations. It also points out the significant differences across locations and clusters in terms of performance and profile at the state and district level. It recommends a bottom-up perspective, focusing on sector-and location-specific initiatives and policies to further enhance the competitiveness level in the country.

The analysis carried out in the next section is on similar lines and further adds to the depth of the available cluster knowledge in the country.

Other Empirical Findings

Growth of Clusters overtime:

The growth rates¹⁷ of employment and productivity vary among the cluster categories. The employment growth in the country is led by agriculture and local clusters, whereas the traded cluster contributes more to productivity growth. This pattern is observed in other economies as well.

Type of Cluster	Employment Growth	Productivity Growth
Agriculture	5.85%	2.41%
Traded	1.24%	4.67%
Local	4.41%	2.29%

The substantial shift of labour in favour of agriculture has not been able to transform into higher productivity. In four years, it has grown at a slow rate of about 2.4%, and its average wage and payroll (total income) are the lowest among the three types of clusters. The productivity growth in local clusters was about 2.2%, slightly less than in the agriculture cluster. The low rate of productivity growth is due to the small size of the local market, which restricts their growth opportunities. As expected, traded clusters grew at the lowest rate of about 1.2% in size but at the highest rate of 4.7% in productivity. The average wages in the traded cluster are roughly 25% greater than the local cluster. This is because traded cluster competes in the cross-regional markets and is less constrained by the size of the local markets. Moreover, over four years, the gap between traded and local clusters in terms of average wages has risen.

¹⁷ The growth rate is measured between 2017-18 and 2020-21, through extracted PLFS-Cluster mapped data of individual year.

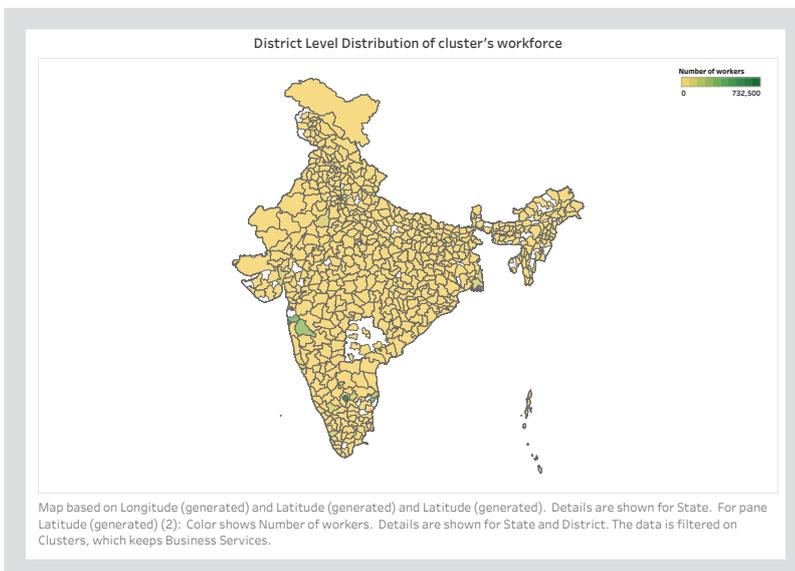
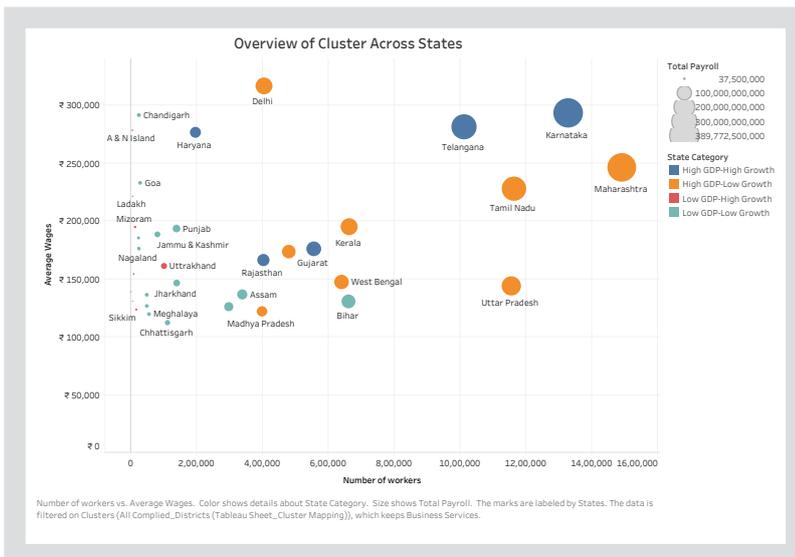
Twenty-three clusters have grown in productivity but have shrunk in terms of size. It indicates a significant increase in technology usage and gains from positive spillover among clusters, eventually leading to decreasing dependency on the labour force. Aerospace Vehicles and Défense, Metal mining are an example of such clusters. On the other hand, clusters like Forestry, Local Community and Civic Organizations, Local Health Services and Local Personal Services (Non-Medical) have shown impressive growth of above 9% in size.

Geographical Footprint and Composition of Clusters:

All clusters present in a region are crucial and worth of study as they provide crucial insight about the local regional economy. Thus, this part of the paper explores the varying localization patterns of the growing clusters across the country. The geographic footprint and structure of clusters is discussed, using simple yardsticks like size, productivity, specialization, and cluster strength. For this purpose, few clusters were chosen based on their size, growth in size and productivity.

Business services:

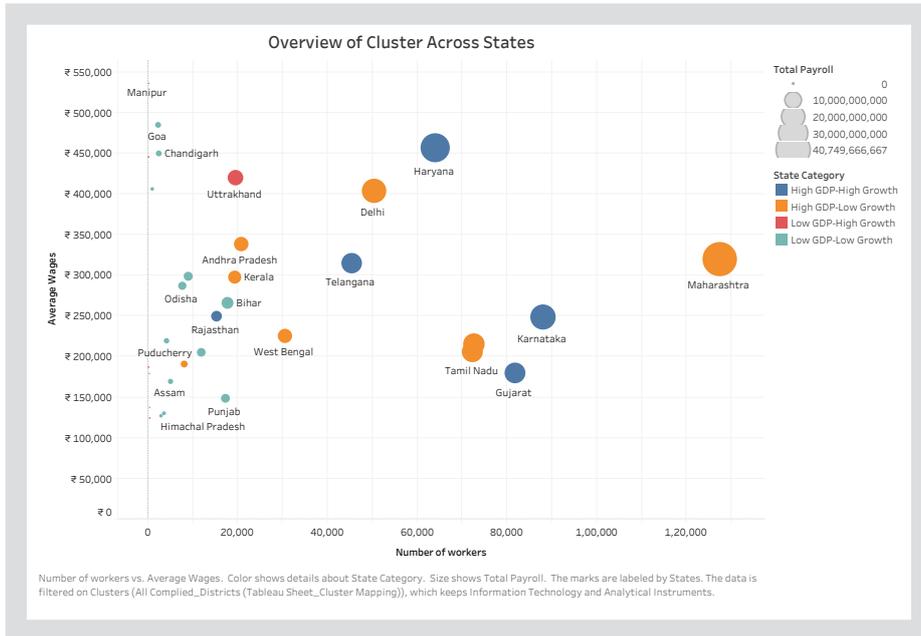
It is the highest employment-providing cluster in India, similar to the other developed economies.



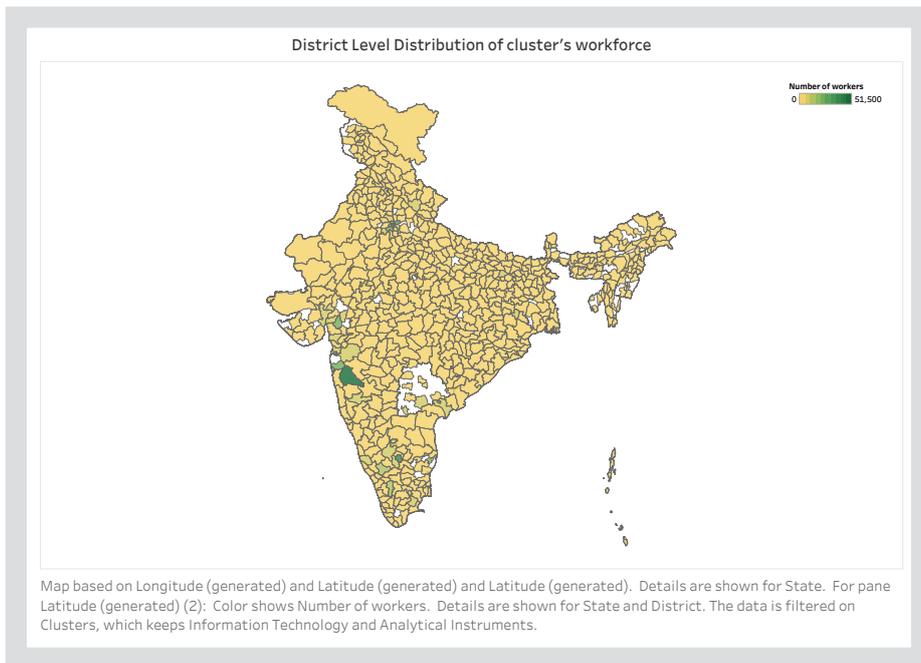
The cluster is active in around 660 districts and is almost evenly distributed across 36 states and union territories of the country. High GDP states like Maharashtra, Karnataka, Tamil Nadu, Telangana, Gujarat, and few others account for 80% of the employment and payroll of the cluster. Though Business services is not one of the highest productive clusters in India, still its average wage is significantly higher than the national average. It is majorly driven by regions like Delhi, Karnataka, and Chandigarh. The workforce is noticeably dominated by skill-2 and skill-4 workers across the regions, who are mostly either regular salaried workers or self-employed. 31% and 48% of employment and payroll are concentrated in the most prosperous (Top 70) district group, while the Middle group had 41% and 36%, respectively. Among the 35 districts which have 3-star strength of the cluster, 23 belong to the Top 70 category, followed by 12 belonging to the middle group of districts.

Information Technology and Analytical Instruments:

It is one of the fastest-growing clusters in terms of both size and productivity.



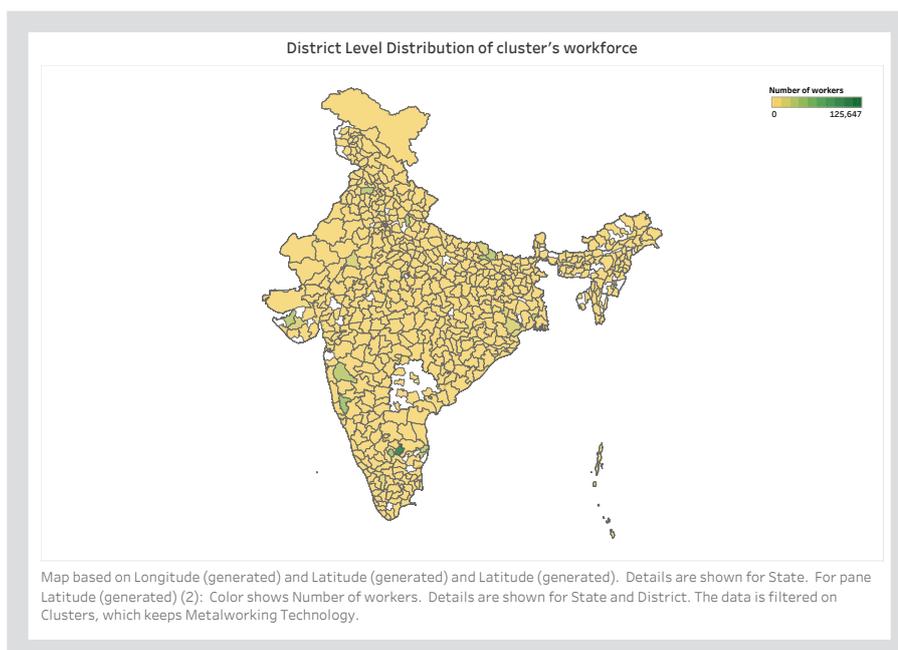
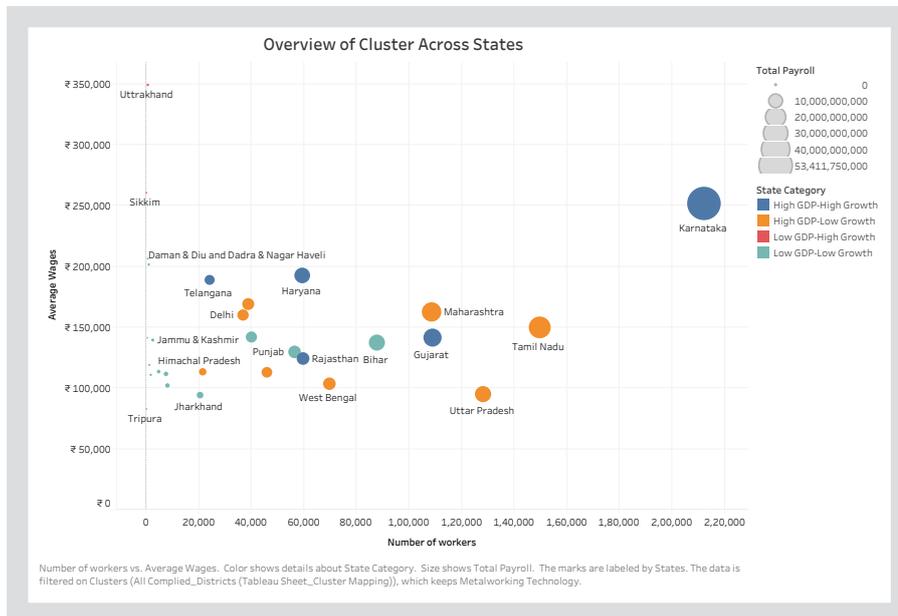
Presence of the cluster is not evenly spread across the country. It is present in only about 191 districts in major states and union territories like Maharashtra, Karnataka, Tamil Nadu, Delhi, Chandigarh and a few others. In the majority of the regions, the cluster is an urban sector dominated both in respect of workers and payroll contribution, with a few exceptions of regions like Uttarakhand, Himachal Pradesh and Jammu and Kashmir. In addition, it is among the few clusters with nearly 25% contribution in the workforce and payroll from females. States with more than 50% of participation of females in the cluster workforce are majorly rural dominated, except for Sikkim. Across all regions, Information Technology and Analytical Instruments cluster majorly consists of regular salaried and self-employed workers, dominated by the former.



Out of the 191 districts, only nine like Gurgaon, Pune, Hyderabad, Gandhinagar, and North-East Delhi, have the presence of a 3-star cluster, making them the hotspot regions of the Information Technology and Analytical Instruments. Other well-known regions for the clusters like Bangalore, Gautam Buddha Nagar (Noida), and Kolkata only have a presence of two or one star.

Metalworking Technology:

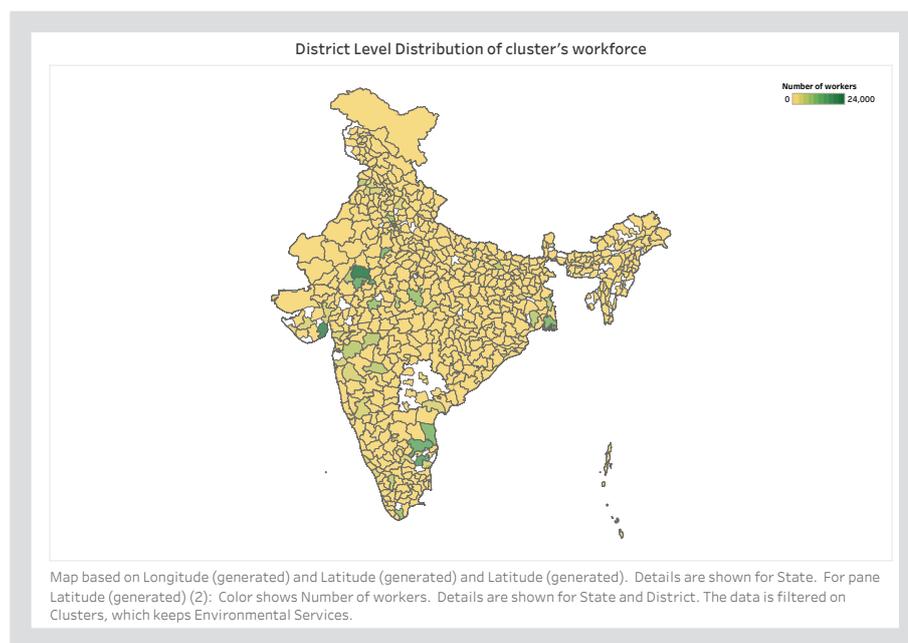
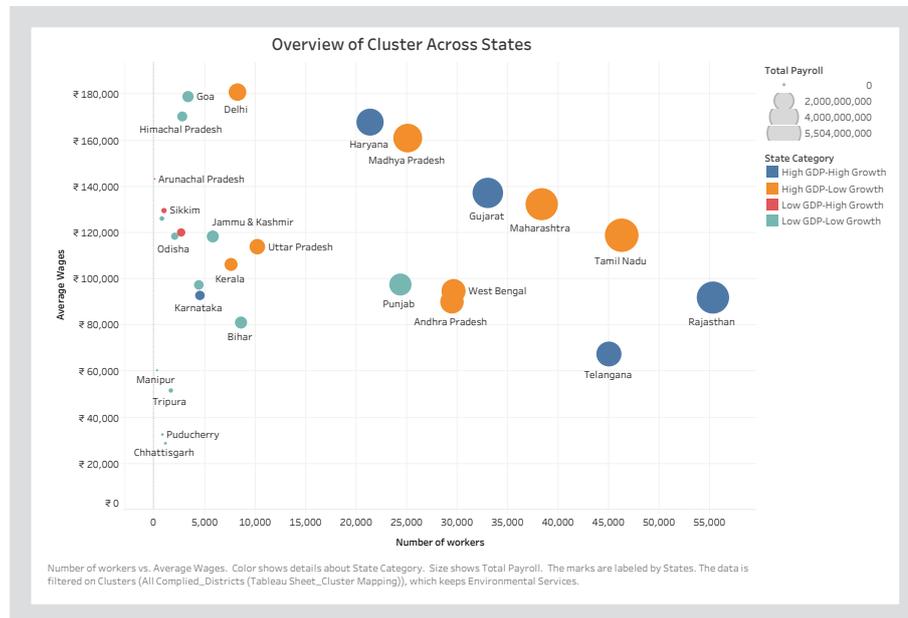
Cluster has also experienced significant employment and productivity growth over the years.



The cluster is spread across 225 districts, majorly in the high-GDP states of Karnataka, Maharashtra, Gujarat, Uttar Pradesh, and Tamil Nadu. It is labour intensive and comprises of about 95% workforce as males in almost every region. About 80% of skill 1 and skill 2 workers, which are considered low-skilled workers are engaged in the cluster. The middle category of districts contributes significantly to the cluster's employment (52%) and payroll (46%). Six out of eight districts with 3-star strength in the Metalworking Technology cluster also belong to the middle category of districts. At the state level, Karnataka is the only state having a 3-star strength, while other states like Gujarat, Haryana, and Tamil Nadu have 2-star cluster strength.

Environment Services:

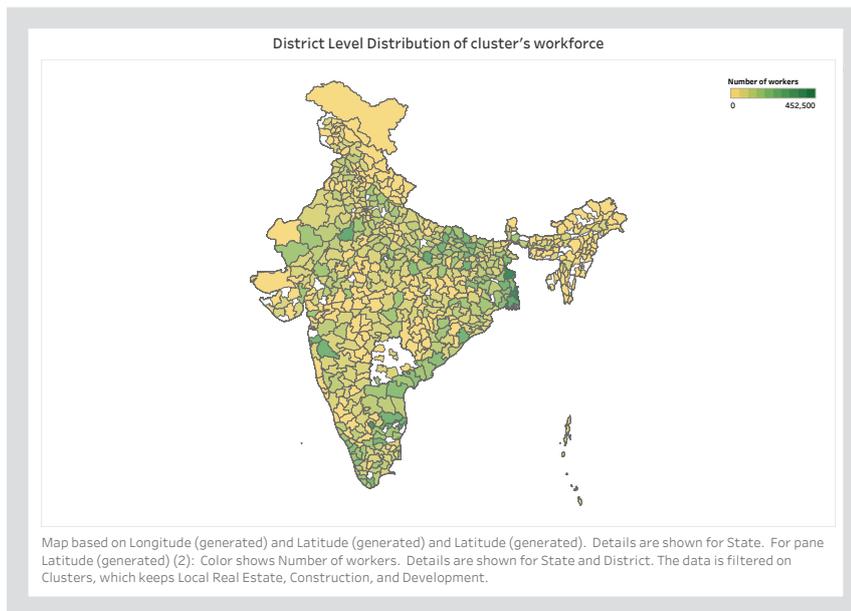
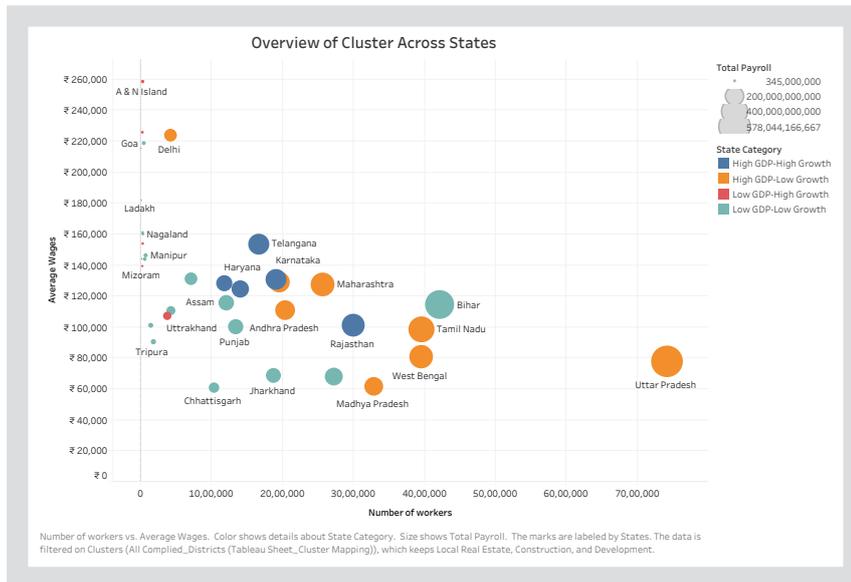
Environment awareness among the people is expanding, and so its cluster. However, its overall size is noticeably below the national average.



The cluster is present in only about 110 districts of the country, which majorly belong to the middle or bottom group of districts. The middle group contribute about 47% and 48% to the cluster's workforce and payroll, whereas the top 70 districts constitute only 18% and 25%, respectively. Like most other clusters, it is also an urban and male-dominated cluster but with few exceptions like Manipur and Sikkim. The cluster is strongly specialized (above 95 percentile of Location Quotient) in 35 districts dispersed majorly in the states of Telangana, Rajasthan, Haryana, Punjab, Tamil Nadu, Goa.

Local Real Estate, Construction, and Development:

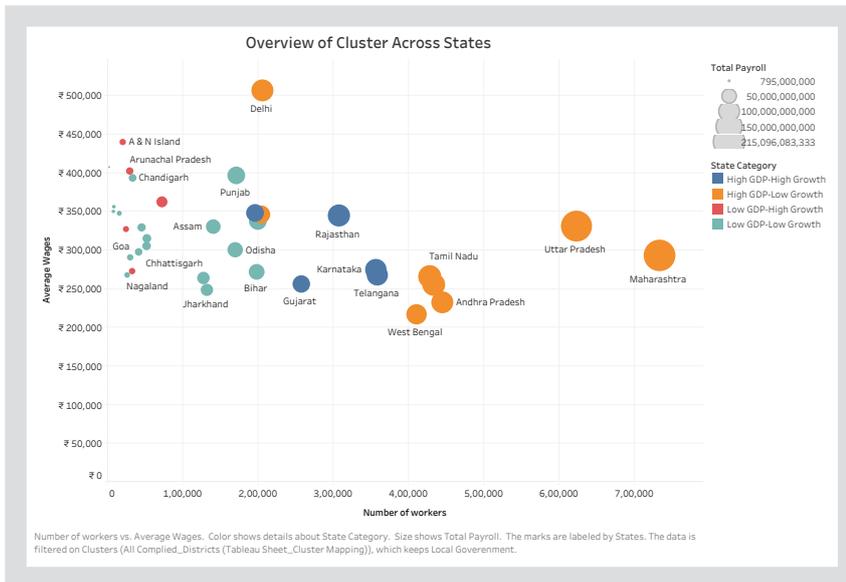
Provide the highest employment among the local clusters in the country. Its growth rate in terms of size and productivity is above the local clusters average.



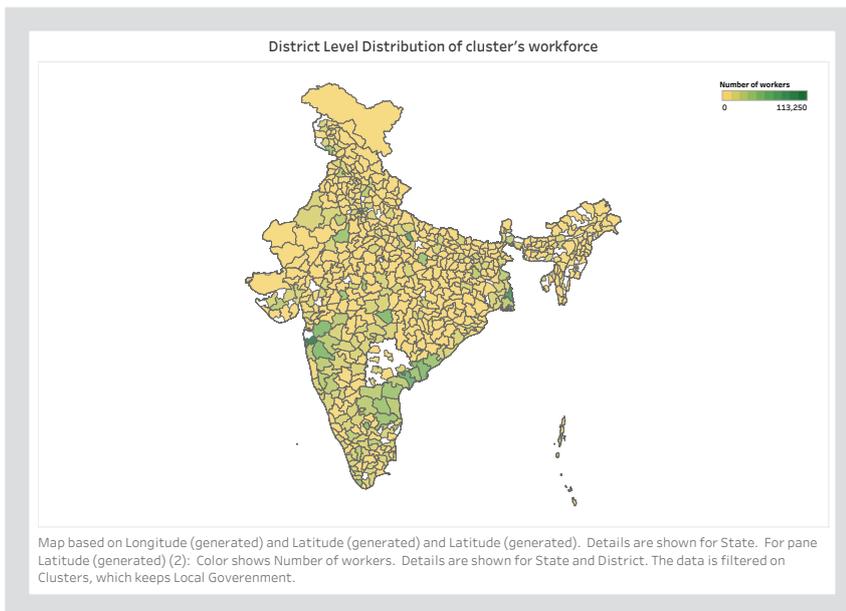
It is present in almost every district (677) of the country, though 70% of its employment and payroll is concentrated among high GDP states. Uttar Pradesh, Tamil Nadu, Bihar, West Bengal significantly contribute to its large size. This pattern is reversed when we break-down the employment and payroll by groups of districts. The middle group contributes to almost half of the employment and payroll, whereas the top 70 prosperous districts contribute merely a share of 8% and 14%, respectively. This indicates that the cluster is largely active in the backward districts of the prosperous states. The cluster is rural, and male dominated. 72% of employment and 63% of payroll is concentrated in the rural regions. The share of women in employment and payroll is below 12%. The cluster has an overwhelming share of about 85% of the casual workers having low skills (skill 1 and skill 2). Only three districts have a 3-star presence of the cluster. It is the one-star presence in many regions that drives the cluster's strength.

Local Government:

This cluster was newly created in Indian cluster definitions due to its unique presence and characteristics in the country.



The cluster has approximately equal share of rural and urban workforce. It has a substantial presence of 23% of women workers, though their average wages are approximately half of their counterparts, on an average. Southern states of Kerala and Tamil Nadu have close to 40% of the cluster workforce as females. In addition to the Aerospace Vehicles and Defence cluster, it is another cluster which has 100% of regular salaried workers. It has a greater presence (45%) of skill 2 workers and about 17% of every other skill type.



Fourteen districts have a 3-star strength in the cluster. They are: Three Districts of Delhi (New Delhi, North-West Delhi, South-West Delhi), 2 of Kerala (Kannur, Thiruvananthapuram), 2 of Uttar Pradesh (Ghaziabad, Lucknow) and one of the other seven states. Ten of these belong to the top 70 district group, and the rest belong to the middle category.

The above discussion of few but important cluster categories, form the basis for the insights required by the stakeholders and policymakers for their decision making. It is important to identify the growing clusters and understand their composition along with their geographical footprint. The economy's ability to produce high-value products and services depends on the creation and strengthening of clusters at the regional level of states and districts.

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