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Mapping the Socio-Economic Development in Pune Division using Wrocklow Taxonomic Classification Method

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Abstract

This study investigates the spatial and temporal distribution of socio-economic development within Pune Division from 1991 to 2011. Utilizing a combined composite index methodology, the analysis focuses on three key variable categories: demographic, economic, and social indicators. The objective is to identify regional disparities in socio-economic development across these dimensions. By examining demographic factors, the study explores variations in population density, age structure, and literacy rates. Economic indicators, such as employment rates, industrialization, and per capita income, are analyzed to assess economic disparities. Social indicators, including access to education, healthcare, and basic amenities, are considered to evaluate the quality of life and social well-being. The combined composite index method allows for a comprehensive assessment of socio-economic development by integrating these three dimensions. This approach enables the identification of regions with high or low levels of development, as well as disparities within each category. The study highlights the unevenness of development patterns across Pune Division, providing valuable insights for policymakers and planners in addressing regional imbalances and promoting sustainable and equitable development.

Introduction

Socio-economic development is a multifaceted process aimed at improving the quality of life for individuals and communities. It encompasses a wide range of factors, including economic growth, social equity, environmental sustainability, human development, and governance. Economic growth, while essential, must be balanced with social equity to ensure that the benefits of development are shared equitably. Environmental sustainability is crucial to ensure that development is not at the expense of future generations. Human development, including investments in education, healthcare, and nutrition, is essential for creating a skilled and healthy workforce. Strong and accountable institutions are vital for promoting good governance, transparency, and the rule of law.

Several challenges can hinder socio-economic development, including poverty, inequality, environmental degradation, governance issues, and conflict. Addressing these challenges requires a comprehensive approach that involves promoting inclusive growth, sustainable development, good governance, human development, and international cooperation. By implementing effective strategies, countries can achieve sustainable and inclusive socio-economic development, improving the lives of their citizens and contributing to a more equitable and prosperous world. This study examines the importance of public facilities like schools and hospitals in Pune Administrative for fostering socio-economic development. While the Human Development Index (HDI) is commonly used to measure development, it has limitations. By analyzing the availability and quality of public facilities, we can gain a more comprehensive understanding of the region's progress and identify areas where improvements are needed to ensure sustainable and equitable development for all.

Socio-Economic Characteristics of Pune Division

Development is a complex and ongoing process. There are many tools and techniques to measure the development, but most of the methods have their limitations. One of the major limitation comes from the assumptions made about the indicators used and how much importance they are given in the overall evaluation. Considering the limitations in various methods like Principal Component Analysis (PCA), Factor Analysis, Aggregation method, Monetary Index Method, Ranking Method etc., we have adopted a simple method for estimating the development. A Composite Index Method of Development allows us to rank and categorize different regions based on their socio-economic and demographic characteristics. It is useful for identifying model regions for less developed ones and setting targets for improvement. The method also helps us to understand how different sectors of development are

interconnected. The main problem comes from the assumptions we make about the developmental indicators and how much importance they have in the overall index. To solve this issue, we use the Wroclow Taxonomic Method, which is a statistical approach developed by Florek et al. in 1952. This method helps determine homogeneous units or types of things in a multi-dimensional space. In 1967, Professor Zygmunt Hellwig suggested using this taxonomy method to rank and compare countries' development to UNESCO. According to Harbison et al. in 1968, this method is useful for interpreting statistical data, establishing a measure of social and economic maturity, and introducing a concept of the pattern of development for planning purposes. Gostowski in 1970 argues that taxonomic distance is a more sensitive and valid measure of development levels because it considers the dispersion among component indicators, showing structural similarities among districts. This makes it useful for establishing development models.

Various studies, including those by Harbison et al. (1968), Land (1975), Ewusi (1976), Arief (1982), Narain et al. (2003, 2009, 2012), and Bhatia and Rai (2004), have used this method for different purposes. In this study, we provide a brief introduction to the Wroclow Taxonomic Method used to overcome the limitations in evaluating the level of development.

The assessment of socio-economic development is a challenging task as it involves a lot of dimensions to be considered. For the present study, total 28 socio-economic indicators have been selected. The selection of these indicators are based on the relationship or association between them. The relationship between the socio-economic indicators was formulated with the help of correlation method. The most correlated indicators were selected for the present study. The following socio-economic indicators have been selected for the analysis:

1. Urbanisation (%)
2. Population Density
3. Population Growth (%)
4. Birth Rate (%)
5. Death Rate (%)
6. Total Population
7. Main Workers (%)
8. Marginal Workers (%)
9. Total Workers (%)
10. Non Workers (%)
11. No. of Co-Operative Societies
12. No. of Agricultural Co-Operative Societies
13. No. of Banks
14. Tehsil Total Income (In Thousand Rupees)
15. Expenses on Public Security (In Thousand Rupees)
16. Expenses on Health Facilities (In Thousand Rupees)
17. Expenses on Public Infrastructure (In Thousand Rupees)
18. Expenses on Education (In Thousand Rupees)
19. Total Expenses of Tehsil (In Thousand Rupees)
20. SC Total Population
21. ST Total Population
22. Male Literacy (%)
23. Female Literacy (%)
24. Total Literacy (%)
25. Sex Ratio
26. No. of Hospitals
27. No. of Primary Health Centres
28. No. of Beds

The Wrocklow Taxonomic Method uses multiple variables to measure the level of development in the different regions. The limitation arises from the units of measurement as each one of them are not always uniform in nature. For example, the population density is measured in the number of female per thousand males whereas, the expenses on the education is in thousand rupees. Hence, to overcome this problem this method normalize the entire dataset of variables into a standardize variables and then the further analysis of procedure will be carried out. For the present study, consider the matrix $[X_{ij}]$ representing the variable values for the i^{th} district and j^{th} indicator, containing 28 socio-economic indicators for each district and tehsil. Where [i] ranges from 1 to n (number of districts / tehsils) and [j] ranges from 1 to n (number of indicators). Each district / tehsil is represented as a vector in a k-dimensional space. Given the non-uniform units of measurement for the considered variables, the matrix $[X_{ij}]$ is converted into a standardized indicators matrix $[Z_{ij}]$ to enable comprehensive analysis.

To standardize the data matrix $[X_{ij}]$ into $[Z_{ij}]$ the following formula is used:

$$[Z_{ij}] = \frac{X_{ij} - \bar{X}_j}{\sigma_j}$$

Where,

$$\bar{X}_j = \frac{\sum_{i=1}^{N} X_{ij}}{N} \text{ and } \sigma_j = \left(\sum_{i=1}^{N} (X_{ij} - \bar{X}_j)^2 \right)^{1/2}.$$

After the calculation [Z_{ij}] matrix of standardize variables, the best value from each indicator in [Z_{ij}] is to be identified. This value is also be called as optimal value of each indicator. The identification of the best or optimal value is dependent on the direction of impact of each indicator (Positive or negative) on the development. For example, in the country like India, higher sex ratio is a sign of socio-economic development while the less expenses on the education may restrict the literacy rate causing low levels of socio-economic development. In this way the optimal value for each indicator (Maximum or minimum) has been determined and it is denoted by the [Z_{0j}]. There were many limitations in the determination of optimal value for each selected indicator for the present study. For example, many studies have underlined that higher population density is unfavourable for the development. But, the regions having higher population density is also a sign of good infrastructural facilities and sufficient employment opportunities. On the one hand the same indicator can play a dual role in determining a development pattern across the different areas. In such cases, we have relied on the existing literature and our own understanding about the study area and then decided the direction of impact of such indicators. After overcoming these limitations, the next step is to find out the development pattern [C_i] for each district / tehsil. To figure out the development pattern C_i for the districts / tehsils, first we have calculated the data matrix [P_{ij}] containing the deviation of each value of standardized matrix [Z_{ij}] to the optimal value in Z_{0j}. For calculating P_{ij} the following equation is used: $\mathbf{P_{ij} = (Z_{ij} - Z_{0j})^2}$

Now, the development pattern [C_i] can be obtained by the following:

$$C_i = \left[\sum_{j=1}^{k} P_i/(cv_j)\right]^{1/2}$$

Where, (CV_j) is the coefficient of variation of j^{th} indicator in the data matrix [Xij]. In a simple words it is a ratio between mean of each indicator to its standard deviation.

Then the composite index of development (D_i) is obtained by:

$$D_i = C_i / C \quad (29)$$

Where,

$$C = \overline{C} + 3\sigma C_i$$

Where,

$$\bar{C} = \frac{\sum_{i=1}^{N} C_i}{N} \quad \text{and} \quad \sigma C_i = \left(\sum_{i=1}^{N} (C_i - \bar{C})^2\right)^{1/2}$$

With this method, the D_i values for each district and tehsil is calculated. These values are ranged from 0 to 1. The district / tehsil having a value close to zero depicts the higher level of development and vice versa.

Results and Discussion

On the basis of development index values of each indicator it is easy to rank the tehsils according to their values (Where the value close to zero will be ranked as 1 and vice versa) for the classifying the number of tehsils into different categories of development. But, this will only be helpful in providing rank order of development of the different tehsils. To see the stages of development among the tehsils it is important to categorize them with a suitable and more meaningful fractile method. Therefore, the classification of the tehsils into different stages of development provides more meaningful characterization. For this purpose, Mean and Standard Deviation of the composite index for each variable i.e. demographic, social, economic and combined of all are helpful for deciding categorization of tehsils into different stages of development. Hence, the distribution of all the composite values are assumed to be normally distributed. Then using the normal distribution curve or a bell shaped curve it is assumed that the tehsils having index value less than or equal to (Mean – SD) are considered as very high developed and accordingly the tehsils falling into this category are classified as Category-I (Stage-IV) of developed tehsils. The tehsil values falling between (Mean-SD) to (Mean) are classified as high developed and put in Category-II (Stage-III) developed tehsils. Similarly, the tehsils having their composite index value between (Mean) and (Mean + SD) are classified as Low developed (Category-III) or (Stage-II) and the tehsils having the composite values greater than (Mean + SD) are classified in Category-IV (Stage-I) very low developed tehsils.

The classification and categorization of tehsils from each district is an important aspect of this study. This type of categorization of the tehsils not only provides a meaningful division but also gives an insights about the various aspects of development across the tehsils and well as districts. It is also possible to measure the significance between different socio-economic and demographic indicators. The following Table 1 are calculated based on the Mean and Standard Deviation of each composite indices. The table provide the limits for the categorization of each tehsil depending upon their demographic, social, economic and overall socio-economic development for the respective years.

Table 1: Limits of Composite Indices for Different Stages of Development

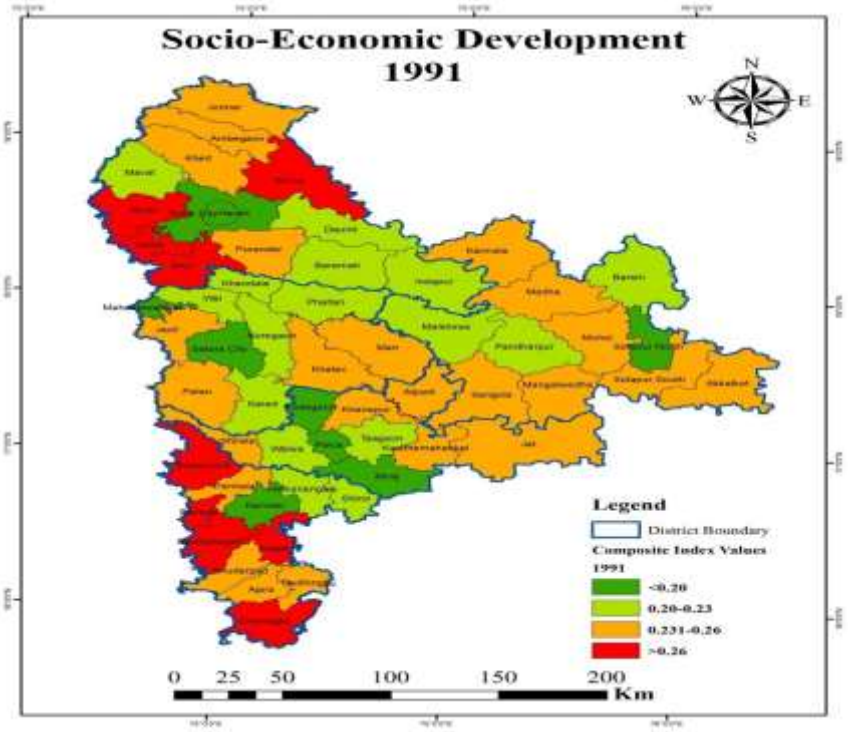
Variable	Composite Indices		Limits of Composite Index for 1991			
	Mean	S.D.	Very High Developed	High Developed	Low Developed	Very Low Developed
Demographic	0.13	0.03	<0.10	0.10-0.13	0.14-0.16	>0.16
Economic	0.14	0.02	<0.12	0.12-0.14	0.15-0.16	>0.16
Social	0.22	0.03	<0.18	0.18-0.22	0.23-0.25	>0.25
Socio-Economic	0.23	0.03	<0.20	0.20-0.23	0.24-0.26	>0.26
Variable	**Composite Indices**		**Limits of Composite Index for 2001**			
	Mean	**S.D.**	**Very High Developed**	**High Developed**	**Low Developed**	**Very Low Developed**
Demographic	0.15	0.03	<0.12	0.12-0.15	0.16-0.18	>0.18
Economic	0.09	0.01	<0.08	0.08-0.09	0.10-0.11	>0.11
Social	0.22	0.04	<0.18	0.18-0.22	0.23-0.25	>0.25
Socio-Economic	0.16	0.02	<0.14	0.14-0.16	0.17-0.18	>0.18
Variable	**Composite Indices**		**Limits of Composite Index for 2011**			
	Mean	**S.D.**	**Very High Developed**	**High Developed**	**Low Developed**	**Very Low Developed**
Demographic	0.20	0.03	<0.17	0.17-0.20	0.21-0.23	>0.23
Economic	0.18	0.06	<0.12	0.12-0.18	0.19-0.24	>0.24
Social	0.08	0.02	<0.06	0.06-0.08	0.09-0.10	>0.10
Socio-Economic	0.15	0.04	<0.12	0.12-0.15	0.16-0.19	>0.19

Source: Calculated by author

Level of Socio-Economic Development in 1991

The socio-economic development is the combined effect of social and economic indicators selected for the present study. The socio-economic development is also dependent on the other factors like agricultural practices, availability of water, infrastructural facilities, connectivity of roads and railways and many others. The composite index values of socio-economic development is computed on the basis of 28 different social, economic and demographic indicators. The composite index values of each tehsil for the year 1991 are depicted in the Table 1 with their stages of development. These composite index values of socio-economic development varies from 0.141 to 0.303 marking the difference of 0.162. According to the ordinal ranks of the tehsils Palus tehsil ranks first while Chandgad ranks last in terms of socio-economic development. The other top four tehsils are Kadegaon, Pune City, Solapur North and Miraj while, the other bottom four tehsils are Shahuwadi, Mulshi, Shirur and Bavada. Out of total 58 tehsils, nine tehsils are classified as very high developed (Stage IV) having their composite index values less than 0.20 (Figure 1). Another nine tehsils are classified as very low developed (Stage I) having their composite index values more than 0.26.

Figure 1: Spatial Distribution of Socio-Economic Development in 1991



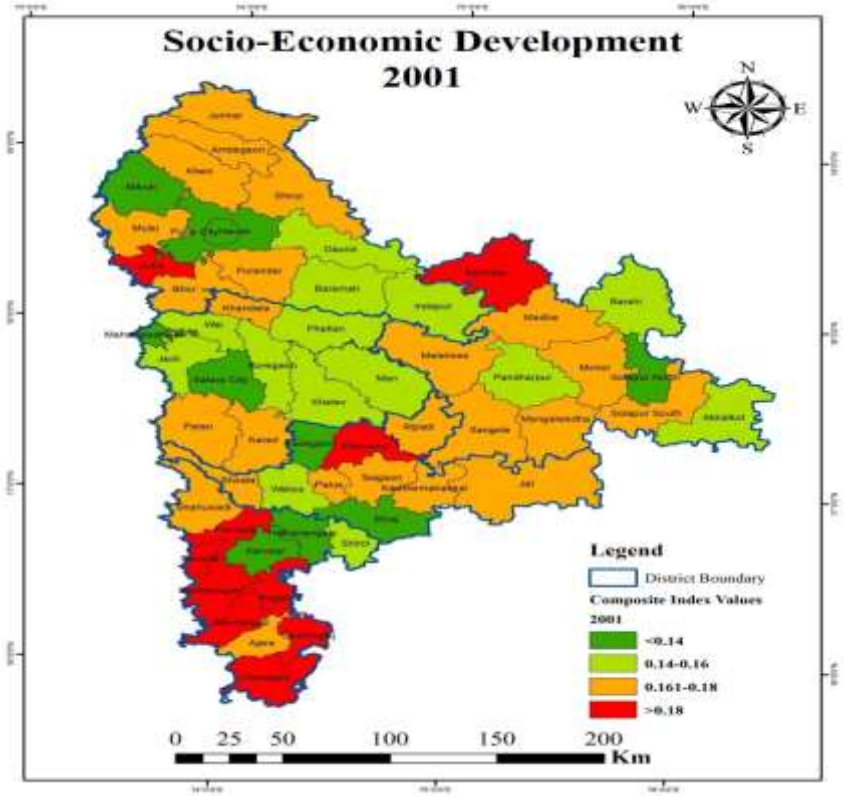
The district-wise distribution of tehsils in the different category of socio-economic development shows that four tehsils from Pune district and five tehsils from Kolhapur district are classified as very low developed. While no tehsil from the Sangli, Satara and Solapur districts have reported to have very low socio-economic development in the year 1991. The tehsils of Daund, Baramati, Indapur and Maval are classified as high developed tehsils falling at stage III of socio-economic development. The composite index values of these tehsils ranges in between 0.20 to 0.23. Khed, Ambegaon, Junnar and Purandar tehsils are classified as low developed and their Di values ranges from 0.231 to 0.26. There were four tehsils from Pune district namely, Shirur, Mulshi, Velhe and Bhor which has their Di values more than 0.26 and hence classified as very low developed in terms of their socio-economic status. There are many reasons responsible for the underdevelopment of these tehsils. Broadly, the tehsils like Kagal and Chandgad are located at the border of Maharashtra and Karnataka states. Administratively, these tehsils are located far from the district headquarter than their nearer proximity to the Belgavi city in the state of Karnataka. Also the political reasons played a significant role in the underdevelopment of this tehsils. In case of Chandgad tehsil the physical conditions such as high amount of rainfall, uneven topography, dependency of population mainly on the agricultural activity are responsible for the lower socio-economic development of this tehsil. Also many of the factories in Chandgad tehsil such as Daulat factory has now shut down its productions due to financial problems and corruption at the political level.

Level of Socio-Economic Development in 2001

The district wise distribution of socio-economic development for the year 2001 is depicted in Figure 2. It may be observed that, most of the tehsils from Kolhapur district are classified as very low developed in terms of their socio-economic aspects. These tehsils includes Panhala, Bavada, Radhanagari, Kagal, Bhudargad, Gadhinglaj and Chnadgad. Karveen and Hatkanangale are the only tehsils in the district falls under the very high socio-economic development. While other two tehsils like Shahuwadi and Ajra are at their IInd stage of development and only Shirol tehsil is found to be at its IIIrd stage of development.

Compared to the socio-economic development in 1991, in the year 2001, Pune district shown a progress in socio-economic development eliminating three tehsils from the category of very low development. Also Maval tehsil has shown a progress by going one step ahead from Stage III to Stage IV of socio-economic development during the decade 1991-2001. While other tehsils of Daund, Baramati, Indapur and Purandar kept their position in the same stage of development during the decade 1991-2001. In Solapur district, Karmala falls back by one stage from the previous decade. Akkalkot shown a positive development while Malshiras has stepped by by one stage of development.

Figure 2: Spatial Distribution of Socio-Economic Development in 2001



Other tehsils have shown no progress or no descent during the decade of 1991-2001. The Khanapur tehsil of Sangli district has shown a descent in the progress of socio-economic aspects compared to 1991. Palus tehsil shown a significant decrease by two stages falling from very high developed to low developed category. In case of Satara district, the tehsils of Jaoli, Khatav and Man shown a progress by moving one stage ahead, while the Khandala and Karad tehsil shown a shortfall in the socio-economic development moving back into the stage III. The other tehsils of the district remained unchanged during the decade 1991 to 2001.

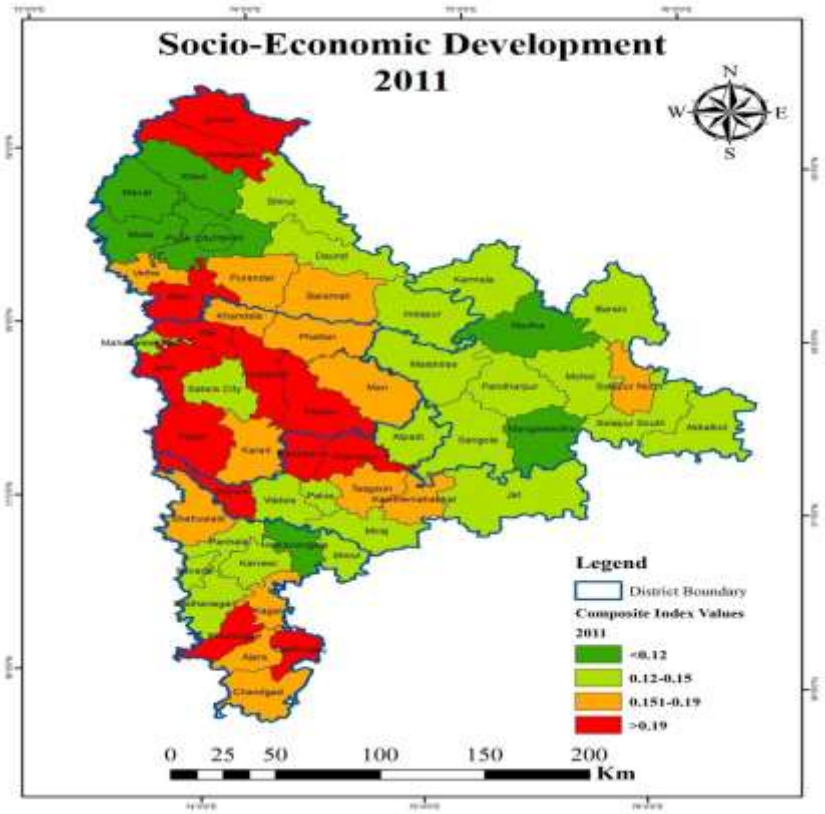
Level of Socio-Economic Development in 2011

The district wise scenario of socio-economic development for the year 2011 is depicted in Figure 3. Junnar, Ambegaon and Bhor tehsils of Pune district are classified as very low developed tehsils. The population characteristics and the economic activities plays a significant role in the social development in these tehsils. Most of the area of Junnar and Ambegaon tehsils is predominantly tribal and mostly dependent on the primary economic activities like hunting and gathering. Due to the inaccessibility of this hilly region, lack of transportation and other facilities, these tehsils are very low developed. Whereas, the tehsils of Pune City, Maval, Haveli, Mulshi and Khed are the major industrial regions which has driven the socio-economic development towards the positive way. About five tehsils of Satara district has classified under very low development category. These tehsils has their composite index values more than 0.19. The tehsils of Wai, Koregaon and Khatav are predominantly a rain fed zone. Scanty of rainfall, low agricultural production and situations of frequent droughts led these tehsil to have very low socio-economic development. Jaoli and Patan are located in the hilly tracts of Western Ghats. These two tehsils has very low amount land under agriculture, large amount of forest cover area and low population density led to minimal development of healthcare facilities, road networks and other infrastructural facilities. The level of income is low in these tehsils as well as the percentage of main workers is lower due to which the dependency of the population is higher. Altogether has impacted on the overall socio-economic development in these tehsils.

In Solapur district, no tehsil falls in the category of very low socio-economic development. Most of the tehsils in the district comes under the vicinity of Bhima river basin. Also the diversification of crops in the agricultural field have led to higher socio-economic development of the region. The changes in the crop combination from food crops to cash crops led higher incomes among farmers and other secondary activities. In Sangli district, three tehsils namely Kadegaon, Khanapur and Shirala are classified as very low developed. No tehsil is observed to have very high socio-economic development in the district. In case of Kolhapur, Bhudargad and Gadhiglaj tehsils falls at stage I of very low socio-economic development. Due to the heavy rainfall in these tehsils, uneven topography are some of the major constraint to the economic

development. Considering the overall situation of socio-economic development the regions close to the industrially developed areas like Pune City has been highly and symmetrically developed in comparison to the central and Southern regions. The geographical profile of the study area such as varying topography, changes in the weather and climatic situations, distribution of the soils and water resources plays vital role in the distribution of population as well as impacting the development process. The results shows that wide disparities in the level of socio-economic development exist among different tehsils within and between different districts of Pune Division.

Figure 3: Spatial Distribution of Socio-Economic Development in 2011



Conclusion:

The combined indices for all the selected variables are calculated for the year 1991, 2001 and 2011 to understand the temporal changes in in the process of development. A comprehensive agenda for socio-economic development of backward districts and other policy measures that need to be undertaken in various districts of Pune Division for bringing out uniform regional development are provided. Considering the overall situation of socio-economic development the regions close to the industrially developed areas like Pune City has been highly and symmetrically developed in comparison to the central and Southern regions. The geographical profile of the study area such as varying topography, changes in the weather and climatic situations, distribution of the soils and water resources plays vital role in the distribution of population as well as impacting the development process. The results shows that wide disparities in the level of socio-economic development exist among different tehsils within and between different districts of Pune Division. The level of development in demographic characteristics is found to be positively and statistically significantly associated with the overall socio-economic development indicating that the growth and progress of these sectors have been going hand in hand in the study area. The results also shown that there is very high association between the Economic Development and Socio-Economic Development in Pune district depicting the correlation value as 0.851 but statistically it is not significant at 0.05 and 0.01 levels as the calculated value is more than the table value. On the other hand the there is a significant relationship between demographic development and socio-economic development at district levels as well as in the entire study area. The correlation values between demographic development and socio-economic development for Sangli district shows negative association. Here the physical conditions or other sectors may play a vital role in deciding the socio-economic development of the region. Therefore, the present study provide scope to conduct further research at regional or at a micro level using variety of indicators which can be collected from the first hand experiences.

References:

1. Florek, K., Łukaszewicz, J., Perkal, J., Steinhaus, H. I., Zubrzycki, S. (1952).

Taksonomia. Wrocławska, Przegla¸d Antropologiczny, Poznan´, XVII.
2. Hellwig, Z. (1967) Procedure of evaluating high-level man-power data and typology of countries by meansof the taxonomic method (unpublished UNESCO working paper). http://unesdoc.unesco.org/images/0001/000123/012349eo.pdf.
3. Harbison, F. H., Maruhnic, I., & Rerwick, J. R. (1968). An evaluation of human resources development indicators, Princeton. http://books.google.co.in/books/about/An_Evaluation_of_Human_Resources_Develop.html?id=S5OttgAACAAJ&redir_esc=y.
4. Frederick, H. H., Maruhnic, J. & Resnick, R. J. (1970). Quantitative analysis of modernization and development. Princeton University Press, New Jersey: Princeton. http://www.jstor.org/discover/10.2307/2721474?uid=3738256&uid=2129&uid=2&uid=70&uid=4&sid=21101091580123.
5. Gostowski, Z. (1970). The use of taxonomic measures in target setting based on international comparisons. Quality & Quantity, 4(2), 355–363
6. Land, K. C. (1975) Theories, models and indicators of social change. International Social Science Journal, XXVII(1), 7–37. http://www.eric.ed.gov/ERICWebPortal/search/detailmini.jsp?_nfpb=true&_&ERICExtSearch_SearchValue_0=EJ121691&ERICExtSearch_SearchType_0=no&accno=EJ121691.
7. Ewusi, K. (1976). Disparities in levels of regional development in Ghana. Social Indicators Research, 3(1), 75–110.
8. Arief, S. (1982). Regional disparities in Malaysia. Social Indicators Research, 11(3), 259–267.
9. Narain, P., Bhatia, V. K. & Rai, S. C. (2012). Pattern of regional disparities in socio–economic in West Bengal. Journal of Indian Society of Agricultural Statistics, 65(1), 27–35. http://www.isas.org.in/jsp/onlinejournal.jsp.
10. Narain, P., Rai, S. C., Sarup, S., & Bhatia, V. K. (2003). Evaluation of economic development at micro level in Karnataka. Journal of Indian Society of Agricultural Statistics, 56(1), 52–63. http://www.isas.org.in/jsp/onlinejournal.jsp.
11. Narain, P., Rai, S. C., Sarup, S., & Bhatia, V. K. (2009). Inter-district variation of socio-economic development in Andhra Pradesh. Journal of Indian Society of Agricultural Statistics, 56(1), 52–63. http://www.isas.org.in/jsp/onlinejournal.jsp.
12. Diddee, J.; Gupta, S. Pune. Queen of the Deccan; Elephant Design: Pune, India, 2003.
13. Carsten Butsch, Shamita Kumar, Paul D. Wagner, Mareike Kroll, Lakshmi N. Kantakumar, Erach Bharucha, Karl Schneider, and Frauke Kraas (2017). Growing 'Smart'? Urbanization Processes in the Pune Urban Agglomeration. Sustainability, MDPI, Basel, Switzerland. 9, 2335; doi:10.3390/su9122335.