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A Geographic Approach to Understanding Sex Ratio and Dependency Ratio in Rural Areas of Jalgaon District

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Abstract
Rural areas of Jalgaon district, Maharashtra are taken for studying sex ratio and dependency ratio trends and its implications for the period from 1961 to 2021. The research employs a mixture of historical census data, surveys and GIS analysis to identify spatial and temporal variations in these demographic indicators, and their socio-economic determinants. A persistent decline of sex ratio across most tehsils reflects deep rooted gender disparities in accordance with cultural norms, access to healthcare and migration patterns. Similarly, the dependency ratio – the ratio between non-working (children and the elderly) to working age population has also seen extensive fluctuation and some tehsils have experienced ease out in the recent years. The findings demonstrate a complex morphology of the interaction between demographic trends and rural economic activities, including in agriculture and migration of labour. Regions with improved resource distribution and education acceses has better demographic indices and regions with inadequate infrastructure have higher gender imbalances and higher dependency mechanisms. The findings underline the necessity of the specific policies, education and health care to achieve balanced demographics and sustainable rural development. For policymakers to design strategies for demographic problems, as well as for inclusive growth in rural India, these insights are vital.

Keywords: Sex Ratio, Dependency Ratio, Spatial Analysis, GIS Analysis

1. Introduction

The dynamics of demographic patterns in the rural areas using the lens of sex ratio and dependency ratio analysis have been presented through a case study of Jalgaon district in the state of Maharashtra, India. They are essential demographic indicators which act as social development and potential economic indicators for rural communities. By now, it has been established to be a key marker for gender balance and social equity in the region [1] already, sex ratio (number of females per thousand males) has become. From this metric we get an idea of how gender-based migration patterns, social preferences and status of women in rural Jalgaon. The dependency ratio, which is the ratio of the population that by and large receives support from the population that by and large yields that support and hence is the ratio

often of the population that characteristically is not in labor force (the dependent class) to population characteristically in labor force (the productive class), is also an important demographic measure. In rural areas, it is well obvious to its importance for economic planning and social welfare programs.

Through two key demographic indicators, complex socio-economic patterns regulating community development and resource allocation in rural landscape of Jalgaon are identified. Recent rural studies show a pattern and the need to institute particular intervention and policy measures. These demographic ratios are of significance in analyzing implications for labor force participation, social security needs, and gender specific development initiatives for rural development planning. Knowledge about these patterns helps policymakers and planners to achieve balanced regional development. The history of sex ratio dependency suggests that regions with industries that rely on certain skills have a feminization of labor that is structured by factors more complex than sex ratio. Sex ratios, however, tend to be skewed and often reflect variations in dependency patterns affecting household economics, and their impact on community welfare programs. This paper represents a demographic analysis of rural Jalgaon to target interventions for demographic balance and rural development with the opening up of the region for a socio-economic transformation. The Jalgaon district area of 11,765 square kilometers (4,530 sq mi) in northern Maharashtra, India, is in the Satpura ranges, and includes the Tapi River basin, is fertile.

1.1 Theoretical Framework

Some of the most important demographic and socioeconomic theories are accepted to constitute a theoretical framework for understanding patterns of sex ratio and dependency ratio in rural areas. To analyze population dynamics in rural contexts the analysis of biological and social factors influencing these demographic indicators is important. Biological factors at birth essentially determine the sex ratio, defined as the number of females per thousand males, but later variations are influenced by social, economic and cultural factors [2]. In rural areas, these variations result from various, and presumably deeper, structural problems regarding gender-based migration, differential mortality rates and the accessibility of healthcare services.

This paper uses demographic transition theory to provide the theory for a dependency ratio analysis and theoretically examines the dependency-ratio relationship. It is through the dependency ratio (the ratio of the dependent population (children under 15 and elderly over 65) to the working age population (15-64 years) which provides a crucial indicator of the level of economic burden and social support that rural communities need. This relationship can be expressed mathematically as:

$$\text{DependencyRatio} = \frac{\text{Population}_{(0-14)} + \text{Population}_{(65+)}}{\text{Population}_{(15-64)}} \text{ x } 100 \quad (1)$$

A theoretical model incorporating demographic and economic factors explains the interconnection between sex ratio and dependency ratio in rural areas. Using this model, we suggest that imbalanced sex ratios can have a dramatic effect on dependency ratios through a variety of channels, including labor force participation rates and household formation patterns and it can represent relation in terms of functional equation:

$$u\,(x_0\,y_0) = inf_{(x1,y1),(x2,y2),\ldots} \sum k \geq 1\, C(xk-1yk-1) \quad (2)$$

In other words, x is the sex ratio components and y the dependency ratio components, as a function of time [3]. This theoretical frame takes spatial dimensions, acknowledging that demographic change in rural areas commonly differ from urban areas. Both ratios are also analyzed as influenced by geographic isolation, agricultural dependency, and limited access to social services.

2. Aim

To analyze the spatial and temporal trends of the sex ratio and dependency ratio in the rural areas of Jalgaon district, examining their socio-economic determinants and implications for regional development.

3. Objectives

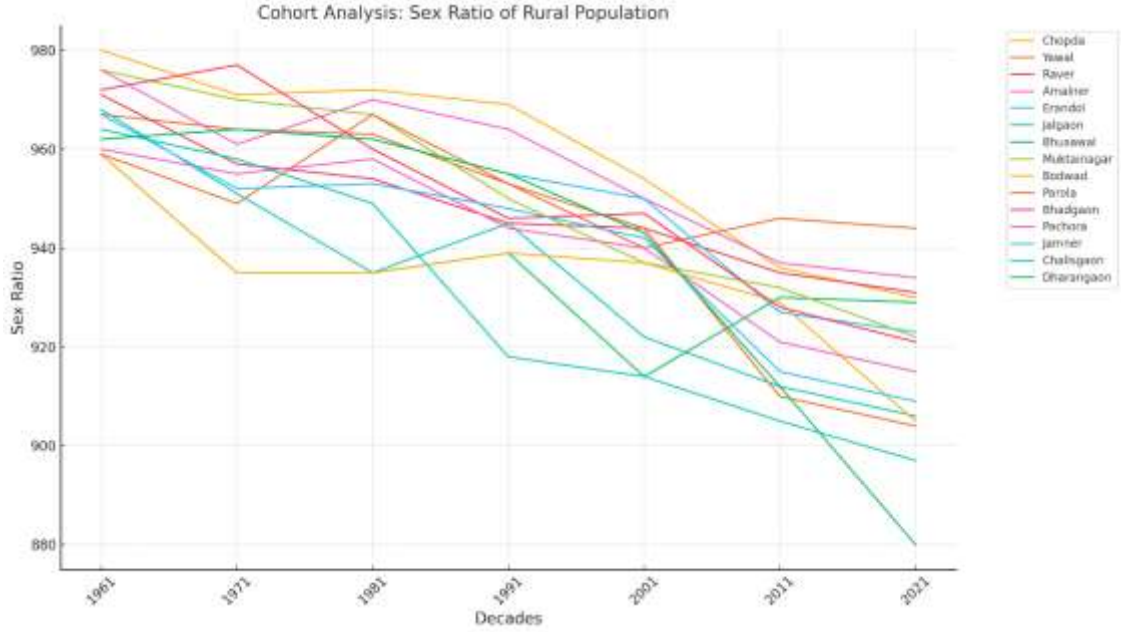
1. To study the historical trends in the sex ratio and dependency ratio across different tehsils of Jalgaon district from 1961 to 2021.
2. To investigate the socio-cultural and economic factors influencing sex ratio and dependency ratio patterns in rural areas.
3. To evaluate the spatial distribution and variations in these demographic indicators using GIS and statistical methods.
4. To explore the relationship between sex ratio, dependency ratio, and rural economic activities such as agriculture and migration.

4. Database and Methodology

A mixed methodology method consisting of primary and secondary data were used in this demographic study to provide complete analysis [4]. Detailed demographic data, especially of sex ratio and dependency patterns, were gathered by a series of systematic household surveys in all fifteen talukas. The sources were made up of Census of India and local administrative records. The study covers the period from 1961 to 2011 that accommodates trend analysis of demographic changes [5]. To maintain data reliability, stratified random sampling was used in the areas, where Jalgaon's diverse rural contexts exist with a 95% confidence level.

Quantitative and qualitative methods were applied to examine the link between sex ratio and dependency ratio in rural areas; the demographic techniques such as cohort analysis and standardized ratios have been used in the study [6]. Sex ratio, females per 1000 males, and dependency ratio (youth plus elderly) were calculated. Demographic patterns across different talukas were illustrated using Geographic Information System (ArcGIS Pro) mapping. To control for socio-economic factors, time series analysis was used to test for temporal trends and regression analysis was performed to quantify the correlation between sex and dependency ratios. An age specific sex ratio was provided to represents gender distribution and the changes over age. Moran's I statistic was used to validate spatial autocorrelation. The quantitative data was supplemented by qualitative insights resulting from this village leader discussions, providing context to the findings. Analysis of Jalgaon district, through this analytical framework, offered a nuanced understanding of the nexus between sex and dependency ratios and made the way for policy recommendations and future research.

Figure 1: Cohort analysis of sex ratio of rural population of Jalgaon district



5. Result and Discussion

5.1 Demographic Patterns Analysis

5.1.1 Sex Ratio Trends

Spatial and temporal variations in the sex ratio have been seen over the last few decades in the rural areas of Jalgaon district. Demographic data show that there are complex patterns in the gender distribution across tehsils in relation to socio economic factors such as migration, cultural preferences and economic opportunities. The sex ratio, defined as the number of females per 1,000 males, has fluctuated strongly in various administrative areas. Over the decades, trends in the sex ratio of the rural population of Jalgaon district have declined, and these declines have been persistant other than in a couple of tehsils. The observed sex ratio of 980–960 during 1961–2021 was decreased to 930–897. In all tehsils, the general sex ratio also declined. For example, the number of villages in Jalgaon tehsil declined from 968 in 1961 to 906 in 2021 and from 964 to 897 in Chalisgaon. The northern Chhoda and Yawal tehsils have a more balanced sex ratio than in southern. This pattern of geography is a product of cultural and economic factors in influencing demographic structure. For short periods sex ratios are skewed by rural-urban migration where the skewedness is primarily male to urban as migrants. Agriculture is shaped by gender distribution in both the male and female processes. During recent years there has been progress in social changes and gender equality which has resulted in higher sex ratios in some tehsils. While benefits are not evenly distributed, certain areas remain short of that equal balance. This temporal analysis of economic development and its relationship with changes in sex ratios documents the relationship between economic growth and changes in demographic parameters. Another way in which sex ratios are also linked to changes in educational opportunities and women's workforce participation in rural areas.

5.1.2 Dependency Ratio Dynamics

Dependency ratio analysis for rural Jalgaon district areas raises variations with different tehsils across 1961 to 2021 period. We see different trends in dependency ratio (the ratio of dependent population or

children and elderly over working age population in different regions of the world. In the district, the dependency ratio rose from 90.28 to 135.57 in Raver Tehsil, one of the highest risings in the district. Whereas Pachora showed declining trend from 97.12 in 1961 to 92.28 in 2021. Temporal analysis indicates marked fluctuations and many tehsils reveal peaks in the dependency ratios within the 1971 period. For Bhadgaon, the highest dependency ratio was 177.02 in 1971.

Age structure, fertility rates and depth of the migration dynamics make dependency ratios vary. We also find that in tehsils with strong agricultural activity, these ratios have less variation, which suggests that there is a linkage between these economic activities and dependency. More volatile ratios at tehsils near urban centres such as Jalgaon and Bhusawal are likely the result of people migrating out for finding local opportunities. A demographic transition towards a more balanced age structure is indicated in most tehsils by a gradual stabilization of dependency ratios. These implications for the provision of social services, economic planning, and resource allocation are dramatic and require the adoption of locational approaches to demographic planning and service provision.

5.2 Socio-Cultural Influences

5.2.1 Traditional Practices

In general, traditional practices have deeply qualified socio-cultural landscape of Jalgaon district and particularly demographics such as sex ratio and dependency ratio [7]. The historical cultural norms have traditionally favored male status over female therefor having often preferred the male child in order not to produce a relative who is not part of your family in case of the death of your family members. This explains disparity in healthcare, nutrition and education. This reinforces what we already know, that gender is predetermined through patrilineal inheritance meaning property and land is passed through males [2]. In Jalgaon of rural India, one is devastated without male children and property. Despite the illegality of the dowry, this practice continues to exist; the dowry has become a social expectation entangled with an economic pressure causing family planning and rural demography to get confused. In particular, such traditions profoundly affect sex ratios, especially in agricultural communities where sons are highly prized to perform farm work and secure support for old age from their parents [8].

5.2.2 Family Structures

Traditional demographic features in rural Jalgaon District are changing with new family structures. Extended ties [7] are preserved by the shift from joint to nuclear families. This born change affects the sex dependency ratio and smaller family units favor, but dependency remains tied to traditional gender role. Agriculture, or land ownership, has also changed, as well as sex ratios. Progress toward challenging traditional gender roles through high schools, college degrees and job opportunities continue slowly. Because of their evolving family structures and changing cultural values, the demographic landscape in India is unlike anything you've ever seen, an unmatched combination of traditional son preference and even beginning to emerge gender equality. The ratio between traditional farming methods and modern economic demands has an impact on the demographic ratios and household composition in communities of agriculture. Rural Jalgaon is highly modernized but its traditional values provide a strong case for comprehensive policy and social interventions.

Figure 2: Sex ratio of Jalgaon district rural population

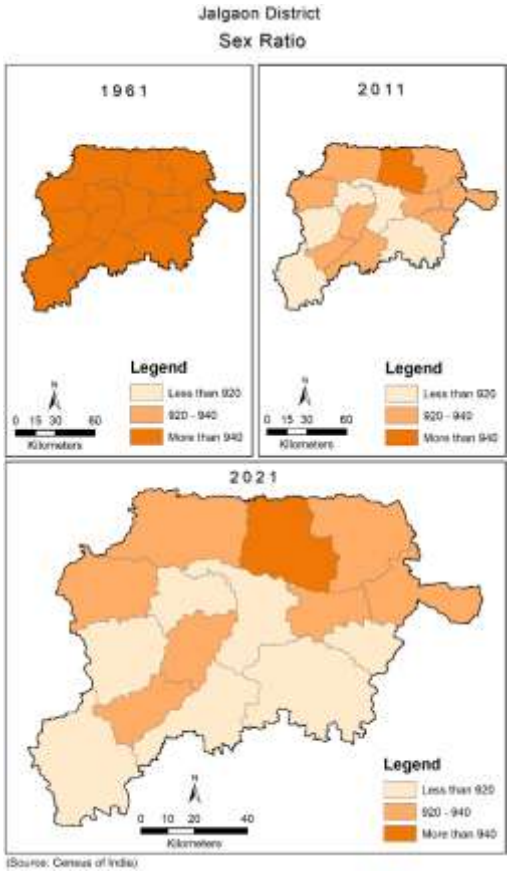
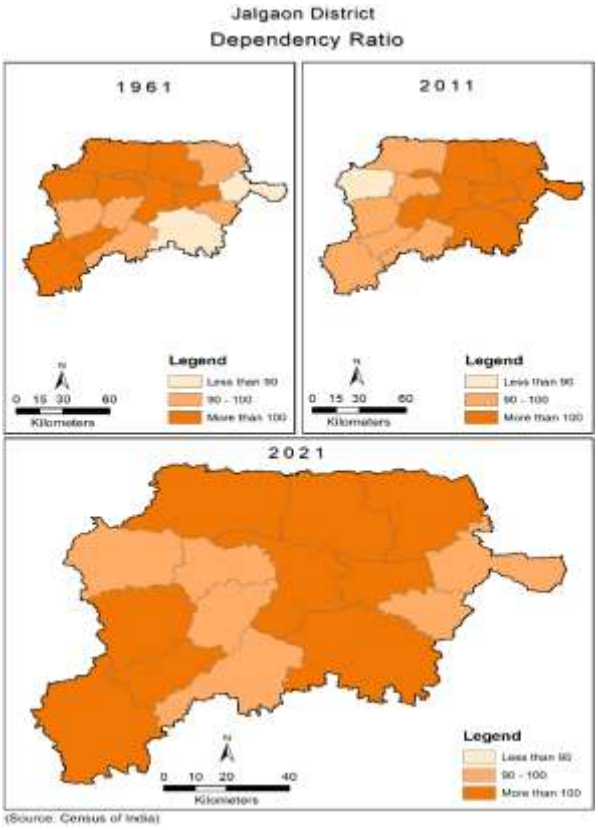


Figure 2: Dependency ratio of Jalgaon district rural population



5.3 Economic Dimensions

5.3.1 Agricultural Workforce

Agriculture, compactness reinforces the demographic features of rural Jalgaon District due to agriculture; it affects the reproductive features, such as the sex ratio and dependency patterns [7]. Sex ratio variation in the gendered agricultural workforce is attributable to men being in core roles. Mechanisation promotes male workers and gets women in to staying in traditional roles [9]. Male migration associated with this seasonal employment alters local sex ratios during peak agricultural time. Much of women's agricultural contribution remains unrecognized. The higher dependency ratio the result of larger household sizes required for farming also indicates the necessity for gender sensitive rural development policies influenced by the linkage between agricultural practice and demographic composition. Jalgaon District is in need of a holistic strategy held in pursuit of the economic and social aspects of rural life.

5.3.2 Resource Distribution

Specific demographic pattern such as sex and dependency ratios is reflected in the distribution of economic resources in the rural communities of Jalgaon District. Family planning and migration are influenced by access to agricultural land, water and equipment that recreate economic hierarchies. Balance sex ratio and low gender inequality occur in communities with better resources. Agricultural resource allocation is connected to wealth distribution and therefore, to rural wealth and family structures. Areas with fair resource distribution show better demographic indices. But imbalances in economic variables compel disparities in education and healthcare involvement including family planning and gender movements. This study underlines the key role economics plays in molding demographic pattern and recommends ways to solve demographically skewed pattern through provision of equitable distribution of resources and economic opportunities. Case study showed that the distribution of resources is associated with demographic indicators, which indicate the ineffectiveness of the holistic approach to rural development that combines economic and social dimensions of the issues.

5.4 Healthcare and Education Access

5.4.1 Healthcare Services

The demographic patterns in the rural Jalgaon District depend heavily on access to healthcare as 56% of persons have inadequate access to healthcare which is 22% in urban areas [1]. While this gap is a challenge for rural communities where there is no adequate medical facility; and there is always a shortage of health profession Demographic imbalances stem from the fact that vulnerable groups, such as those of elderly and women, suffer large disadvantages. The situation worsens, as urban areas attract more young people, who then have poor healthcare access and a consequently concentrate into reduced population distribution which puts a bearing on rural health services. Given the importance of demographic influence of healthcare access, implications for maternal and child health and dependency ratios are provided. The inequalities identified in this report are essential for the demographic balance and sustainable development of Jalgaon District. Making rural residents' demographics more viable could be attained by making rural healthcare structure better; increasing the number of professionals; and offering mobile health services.

5.4.2 Educational Opportunities

Due to poor educational access, sex ratios and dependency patterns are poor in rural areas of the Jalgaon

District. Educational facilities quality influences the family's decision to live and relocate. High dependency ratio has emerged as a challenge due to challenges in the infrastructure establishment and migration of youth in the cities in search of better education. Families with resources always send male child usually town and reduce rural sex ratio even more. As a result, a vicious circle is created of declining population and educational resources which results in even greater migration. Better educational access areas have improved dependency ratios and employment opportunities, which are married sex ratios. For instance, the male to female sex ratio among 15- to 25-year-old is better in villages with secondary schools with 15 per cent increased female literacy in the last decade. Education equitably targeted through educational access, demographics or 'marginals,' are key to improving rural education. Secondary education institutions and higher education institutions are on the rise and universal distance learning programs and incentives to education of girls are extremely important for the development process. Development planning depends on improving educational opportunities in Jalgaon.

6. Correlation and Regression Analysis

6.1 Correlation Analysis:

Correlation Coefficient is 0.030 i.e. very weak positive correlation, while p-value is 0.765 it not statistically significant i.e. it cannot conclude a meaning relationship between dependency ratio and sex ratio.

6.2 Regression Analysis:

Equation of Regression Line: Dependency Ratio=71.44+0.038×Sex Ratio (3)

R-squared = 0.001, suggesting poor fit, however P value on the regression coefficient = 0.765, which is not significant. In the rural population of Jalgaon district no significant linear relationship has been shown between sex ratio and dependency ratio in the decades. This data does not have useful predictive power for the regression model.

7. Conclusion and Recommendations

Patterns of sex population and dependency ratio in the rural Jalgaon district show significant demographic dynamics with important bearing to rural development. However, economic dependency is revealed to show a complex relationship with the gender composition across different areas. It shows prominent sex ratio patterns and outstanding gender imbalances highlighting the necessity of the intervention targeted to the social and economic roots of such disparities. For understanding of economic productivity and social welfare demands of rural communities, analysis of dependency ratio is indispensable. Dependency ratios raise the relative populations already experiencing an aging population, making these communities more dependent on economic strategies and support systems. Additionally, the socio-economic of rural areas is also grasped by looking at sex and dependency ratios, which are critically correlated to one another in their formulation of policies and distribution of resources. This study advocates for a comprehensive approach for rural development based on demographic balance and economic sustainability. These findings can serve as a foundation for local administrators and policymakers as well as for future planning of Jalgaon district with regard to gender equality, job opportunities and social welfare programs. Demographic measurement and analysis are a requirement to evaluate the impacts of policy and successful balanced rural development. Jalgaon's rural

demographic balance can be improved by addressing its root causes and provides a lens for understanding similar demographic challenges in other regions in India and throughout the world.

With regard to dependency and sex ratio, Jalgaon District is in a critical situation for which there is an immediate need for policy actions [10]. Essential are improving rural girls' education, having a scholarship program, and offering transportation aid. They are essential to remote areas [11], being mobile units for maternal and child healthcare. Gender bias must be fought, and financial incentives must be provided for girl child education. To obtain demographic balance and sustainable growth, strategies must take into consideration economic factor, skill development and support for the small industries. At a social and economic level, population balance is dependent on comprehensive long-term planning. In villages with superior education and healthcare, sex ratios are found to be improved [11]. Rural school and building committed to girls' education and economic development building jobs for women. Assessing policy impact requires infrastructure enhancements, and regular monitoring of the demography.

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