DOI : 10.18843/ijms/v5iS1/02
DOIURL :http://dx.doi.org/10.18843/ijms/v5iS1/02

Changing Paradigm of Kerala's Urbanisation Model with Special Reference to JNNURM at Eranakulam District

Archana Aravindan,
Asst Professor,
Department of Commerce
Sree Kerala Varma College Thrissur,
Kerala. India.

Dr. Prasanth Warrier C B,
Asst Professor,
Department of Statistics,
Sree Kerala Varma College Thrissur,
Kerala. India

ABSTRACT

City Expansion and Urbanization of Kerala has marked unique features. Due to the sea shore on the one side of Cochin, Thiruvananthapuram and Calicut, the size of the city expansion is like a half circle where as at Thrissur, Palakkad and Coimbatore is almost in a circular manner. Towards the centre of the city it is seen that the population density has an increasing tendency in other words we can say that all the cities have an outer expanding nature and this expansion is circular. The inter relation between the rank of the city and population is explained by Rank size rule. To analyze the concept, we have studied Cochin and Thiruvananthapuram city population (2001 and 2011) and tested the goodness of fit. The relevance of these years are to understand the effects of pre and post JNNURM. Researcher has also analyzed the urbanization and characteristics of the same based on these areas via JNNURM with respect to the size of the city, and distance from the urban center. The components initiated and implemented in Kochi through JNNURM with the facilitating upcoming projects like AMRUT have been studied. Further the landscape and resources of Cochin and Thiruvanthapuram have also been analyzed by evaluating the community consensus & socio economic viability.

Keywords: Urbanization, City Size, Rank Size, Distribution.

INTRODUCTION:

United Nations Organizations has defined urbanization as the movement of people from rural to urban areas with population growth equating to urban migration. Urbanization refers to general increase in population and the amount of industrialization of a settlement. It includes increase in the number and extent of cities. It symbolizes the movement of people from rural to urban areas. Urbanization happens because of the increase in the extent and density of urban areas. The density of population in urban areas increases because of the migration of people from less industrialized regions to more industrialized areas. It is referred to as the index of transformation to modern industrial one from traditional rural economies.

Urbanization study is a vital necessity to the planners and policy makers. Thus the various factors lead the Urbanization to be probabilistic in nature rather than deterministic. Therefore urbanization is the process of village transforming into towns and towns further developing into cities on the basis of increased modernization, economic developments, social cultural and political changes and the government policies. The spaces where countryside meets town are often amongst society's most valued and pressured places which together form the rural–urban fringe (RUF).

The beginning of urbanization can be traced back to Renaissance times in 16th century. Turkish assaults resulted in movement of Christians from the east to western European countries. As a result, trade grew and European cities along the coasts developed greatly. A further boost for urbanization was formed with the arrival of the "Industrial Revolution".

Table1. Represents the increase in urbanization in the World. Today as compared to Asian and African countries, countries such as USA and UK have a higher urbanization level. Economic forces helped to locate factories and workers in cities. Only 17.8% of population of Third world societies lived in cities in 1950. But by 2000, the percentage had increased to 40%. By 2030, the percentage is predicted to increase to 60%. Around two fifth of total urban growth in the third world is accounted by the rural-urban migration (Gugler, 1988). Australia is the most urbanized country in the world. Both the rate and level of urbanization in Australia are high.

Process of Urbanization in India, as in other developing countries, is being determined by Macroeconomic factors at national and global levels, but it is not strongly linked with to the developments in rural economy. The strategy of economic reform and globalization has given a boost to growth of industries and business in these global cities resulting in inflow of capital from outside the region or country is also investment by local entrepreneurs. . In India, rural urban migration has been found to be modest due to the three factors, Natural growth of population, Rural–urban migration and reclassification of rural areas as urban.

Urbanization Profile of the State of Kerala:

The urban areas in Kerala are comparatively smaller but fairly well distributed within the State. Urbanization profile of the state of Kerala can describe as follows:

Geography and Ecology:

Kerala is the Southern-most State in India having geographical area of about 39,000 sq. km. with population of 33,387,677 as recorded by the 2011 Census. There are four major geographical zones in the State: the Highlands, the Middle zone, the Lowland plain, and the Coastal plain. Kerala is a region of relatively heavy monsoon rain. There are 44 streams/rivers in Kerala.3 The even availability of water rendered possible an even settlement pattern, as distinct from the cluster villages in the rest of the sub-continent, and it helped reducing the chances of rapid spread of epidemics in the region.

Rural-Urban Continuum:

Rural-Urban Continuum: An idiosyncratic feature of the development trends in Kerala is the absence of rural-urban polarisation. The public policy has been so targeted that the disparity between the rural and urban area reduced to the minimum. These developments in Kerala – 'rural-urban continuum' – have resulted in the coinage of a new term 'rurban'. Woodcock (1967), described the situation very beautifully in the following way. Kerala villages bear little resemblance to the tight, squalid settlements of North India which huddle along a single street or in a knot of houses for mutual protection. In spite of their unorganized appearance, the Malayali villages have quite elaborate social structures. Each will have at least one school and a public library; it will have a public health service, trade union branches and political party groups, places of worship and always a few tea shops which serve as meeting places for the various communities. In many respects, it is urban.

Urbanization in the state of Kerala shows marked peculiarities. Generally, increase in urban population growth rate is the result of over concentration in the existing cities especially metropolitan cities. But in Kerala, the main reason for urban population growth is not by the concentration of population in to the existing urban areas, but the increase in the number of urban areas and also urbanization of the peripheral areas of the existing major urban centers. Kerala is experiencing urban spread rather than concentration. Though Kerala is having high urban content in total, it does not have a single primate city but have 6 numbers of medium sized urban agglomerations which are found to be fairly well distributed when analyzed in the context of population distribution.

Initially there were 9 urban agglomerations in Kerala which further increased to a stooping 19% in 2011. In 2001 Census it was Cochin urban agglomeration alone that had the one million plus agglomeration in Kerala but currently it has 7 such one million plus urban agglomerations. Now in Kerala, there are 18 urban agglomerations depicting one lakhs plus population .

Kerala is the third fastest urbanizing state in the Country. From Table 2 & Figure1, by 2011, 48 % of the people is residing in urban area. The population growth rate in the state is in a stabilizing mode, the decadal rate of urbanization is 82 % (2001-11). In 2011 census shows that Kerala witnessed the highest level of urbanization 47.71% as against the national average of 31.16% during 2001-11, with a growth of 83.20% over the previous decade. The analysis shows that new urban jurisdictions of a hitherto rural as urban, due to the shift in the occupational structure from agriculture to other categories of employment causes such a massive urban in the state. It's observes that in a state like Kerala marked by scattered settlement, physical and economic dimension also should be taken into account while describing an area as urban.

Figure 2, depicts the percentage increase in the number of census towns and statutory towns in 2011 in the state of Kerala except in the Idukki district. The figures in itself creates inquisitiveness to understand the pattern, trend and progression of urbanization in Kerala**.** 'Kerala Model of Development' gained concentration in the international ground due to the occurrence of the 'paradox' of high social development indicators and comparatively low economic growth. However, unique human settlement pattern of the state, its capabilities and implications are rarely discussed in economic scenario. Thus Kerala is distinguished with comparatively low population density development in urban areas and high population density in rural areas.(Table 4,Figure3)
The rapid increase in urban populations has meant that peri-urban areas are growing much more quickly than formal urban centres. Peri-urban areas are those areas situated immediately around a town or city. They are areas in transition from countryside to city (rural to urban), often with undeveloped infrastructure, where health and sanitation services are under pressure and where the natural environment is at risk of degradation
The Figure 4 depicts and shows the incremental increase in the Statutory and Census Towns in the state of Kerala. It becomes the need of the hour to understand the primary factors that has led to the progression of urbanization rate in Kerala and also to understand the nuances of its urbanization as well to understand the rate of urban development that has occurred through concentrated urban development programs like JNNURM and AMRUT at Kochi & Thiruvanthapuram. Some of the effect, occurrence, and various variables associated to urbanization and its are mentioned below;
The concept of "Urban Sprawl" means increase in spatial scale or increase in the peripheral area of cities. Mukherji & Shekhar (2001) studied about the Linkage between Migration , Urbanisation and Regional disparities in India. Allen & Lu. (2003) discussed the Modeling and Prediction of Future Urban Growth in the Charleston Region of South Carolina. Human population increase factors were studied by Joel (1995). Philippe Bocquier (2004) detailed World Urbanization Prospects. Later Human population grows up was studied by Joel (2005). Giesen et al. (2010), explained the size distribution across all cities-double Pareto lognormal strikes. Prasanth & Praseeja (2017) discussed a Markov Chain Model for the Demographic study. These studies have thrown an insight into the various facets of urbanization..

Positive impact of urbanization:
The spatial distribution of people in a country reflects its economic activity, material possession and prosperity. The rapidity and the magnitude of differential impact of modern development are so complex that the real mechanics of adjustment of people to economic opportunities comes, more from the distribution by movement than by natural growth. This problem has become serious concern of the planners because an unplanned concentration of people in cities may take away much of the benefits accrued by planned development.
Thriving towns and cities are an essential element of a prosperous national economy. The gathering of economic and human resources in one place stimulates innovation and development in business, science, technology and industry. In cities, child survival rates are better than in rural areas because of better access to health care. The density of urban populations makes it easier and less costly for the government and utilities to provide essential goods and services. For example, the supply of basic facilities such as fresh water and electricity can be achieved with less effort and less cost per person.
Schools, colleges and universities are established in cities to develop human resources. People of many classes and religions live and work together in cities, which creates better understanding and harmony and helps break down social and cultural barriers. Cities also have advanced communication and transport networks.
However, rapid population increases and unplanned growth create an urban sprawl with negative economic, social, and environmental consequences. In Ethiopia, the rate of urban growth often strains the capacity of local and national government to provide urban residents with even the most basic services of housing, water supply, sewerage and solid waste disposal (The Ministry of Works and Urban Development, MWUD- 2008).

Adverse Effects of Urbanization:
The merits of urbanization or urban sprawl are understood by the society but discussion of two sides of the coin is extremely essential to understand urbanization as a wholesome concept. The city and its infrastructure may not be adequately planned. Traffic is high with increased time needed for commuting. Essential services are not reachable within time. City administration becomes extremely difficult.
An excellent example of urban sprawl within our country is that of the city of Bangalore. After the establishment of IT industry in Bangalore, the population exploded from 24,76,355 in 1980 to 42,92,223 in 2001 with influx of 18 lakh immigrants within two decades. The growing population has increased pressure on several resources including civic amenities, residential availability, cost of living, local infrastructure, transport,

traffic and administration. There is escalating competition for facilities due to the high standard of living in urban areas, which has triggered several negative effects. Many people including farmers who move to cities in search of a better life end up as casual laborers as they lack adequate education. This leads to one of the worst problems of urbanization - the growth of slums.

Slums, they are urban areas that are heavily populated with substandard housing and very poor living conditions. As a result several problems arise.

i)Land insecurity - Slums are usually located on land, which are not owned by the slum dwellers. They can be evicted at any time by the landowners. ***ii) Poor living conditions*** - Crowding and lack of sanitation are main problems. This contributes to outbreak of diseases. Utilities such as water, electricity and sewage disposal are also scarce.

Unemployment - Since the number of people competing for jobs is more than jobs available, unemployment is an inevitable problem. ***iii) Crime*** - Slum conditions make maintenance of law and order difficult. Patrolling of slums is not a priority of law enforcing officers. Unemployment and poverty force people into anti-social activities. Slums become a breeding ground for criminal activities. Environmental impacts of urbanization. ***iv) Temperature*** - Due to factors such as paving over formerly vegetated land, increasing number of residences and high-rise apartments and industries, temperature increases drastically. ***vi)Air pollution*** - Factories and automobiles are symbols of urbanization. Due to harmful emissions of gases and smoke from factories and vehicles, air pollution occurs. Current research shows high amount of suspended particulate matter in air, particularly in cities, which contributes to allergies and respiratory problems thereby becoming a huge health hazard. ***vii)Water issues*** - When urbanization takes place, water cycle changes as cities have more precipitation than surrounding areas. Due to dumping of sewage from factories in water bodies, water pollution occurs which can lead to outbreaks of epidemics. ***viii)Destruction of Habitats*** - To make an area urbanized, a lot of forested areas are destroyed. Usually these areas would have been habitats to many birds and animals. Benefits of urbanization Though urbanization has drawbacks, it has its benefits. ***Ix)Efficiency*** - Cities are extremely efficient. Less effort is needed to supply basic amenities such as fresh water and electricity. Research and recycling programs are possible only in cities. In most cities flats are in vogue today. ***x)Convenience*** - Life in cities is much more advanced, sophisticated and comfortable, compared to life in villages. Cities have advanced communication and transport networks. ***xi)Concentration of resources*** - Since major human settlements were established near natural resources from ancient times, a lot of resources are available in and around cities. A lot of facilities to exploit these resources also exist only in cities. ***xii)Educational facilities*** - Schools, colleges and universities are established in cities to develop human resources. A variety of educational courses and fields are available offering students a wide choice for their future careers. ***xiii) Social integration*** - People of many castes and religions live and work together in cities, which creates better understanding and harmony and helps breakdown social and cultural barriers. ***xiv) Improvements in economy*** - High-tech industries earn valuable foreign exchange and lot of money for a country in the stock markets. ***xv) Future of urbanization***: Urbanization is set to stay for a long time. It may be slow but surely does not show any signs of stopping. In 1985, 45% of the world population stayed in cities. Scientists estimate that 60% of the world population will be city-dwellers by 2025. The main goal of urban planning is to make all amenities and comforts available to the public without imposing many negative effects on society and environment, aptly referred to as "Sustainable growth". During city planning it should be ensured that adequate infrastructure is available to support the population. Residences should be conveniently located near the civic bodies. This could improve effective provision of the necessary services.

Opportunities can be created within rural areas to reduce stress on cities. This also results in a higher standard of living for the people of the country as a whole. This reduces the rate of migration. Currently, planning cities for sustainable growth, mainly in the third-world societies, is a major challenge for humanity. Restricting the population boom is another major issue of the third millennium. All these vital factors would decide what the future would look like for humankind and our planet. The primary reason for an undistributed growth of population is the occurrence of Migration and Immigration.

Migration and Immigration:

The movement of people from one place to another is called migration. Migration is influenced by economic growth and development and by technological change and possibly also by conflict and social disruption. It is driven by pull factors that attract people to urban areas and push factors that drive people away from the countryside. Rural-urban migration has both positive and negative effects on the migrants, the place of origin and the place of destination. *World Development Report 200956 : Reshaping Economic Geography* considers

growing cities, ever more mobile people, and increasingly specialized products essential for the economic development.

Positive effects on the area of origin due to migration include increase of share of land holdings, improvement in the economic condition and living condition by the construction of good house etc. At the same time, the social status of the family improves because of education and better social contacts. *Negative effects* on the area of origin experiences some setbacks i.e. shortage of labour is experienced, sometimes movement of young or working force restricts the proper growth of the region. It has been observed mostly that people receive their basic education (technical or general) at the place of their origin but they rarely serve the place of their origin.

Internal migration or which is commonly called *rural-urban migration* plays an important role in the process of urbanization and process of economic development in space. 30 percent of all urban growth in India during 1990's was due to rural urban migration (census Govt. of India 2005). The growth rates in agricultural production and income has been noted to be low, unstable and disparate across regions over the past several decades. Rural urban migration has often been considered the major factor for growth of urban population. A large part of Migration and urbanization in the less developed countries have historically been linked to stagnation and volatility of agriculture and lack of sectoral diversification within the economy. In specific it shows the people mainly move to the places which have witnessed improved growth rate of urbanization and achieved higher economic development compare to the place where employment opportunities are less.

LITERATURE REVIEW:

Rural to Urban migration is a response to diverse economic opportunities across space. It has played a significant role in the urbanization process of several countries continues to be significant in scale, even though migration rates have slowed down in some countries (Lall et al., 2006). The process of urbanization can be identified as over urbanization as long as (1) rural-urban migration leads to a misallocation of labour between rural and urban sectors in the sense that it rises urban employment, under employment and poverty. (2) Rural-Urban migrations increase the social cost providing for a country's population (Gugler, 1988).

Kerala is witnessing large inflow of migrant labour from different parts of the country in recent years. Though labourers from states as far as West Bengal, Bihar, Uttar Pradesh and Orissa now flock to Kerala, those from the neighbouring state of Tamilnadu out number others by a big margin. Higher wages for unskilled labour in the state, large opportunities for employment and shortage of local labour, paradoxically despite the high unemployment rate in the state, led to the massive influx of migrant labour to the state.

With signs of rapid growth of state's economy and the increase in activities particularly in the infrastructure and construction sectors, the in migration is expected to grow faster in the coming years. Studies by concludes that the migrant labourers get much higher monetary wages than in their native places. But, they work for longer hours and their real wages may be lower as they have to incur higher cost of living in Kochi on food, shelter and transport. Their working and living conditions and habits make them suffer from a number of diseases. But their access to public services like health and education is limited. They enjoy very limited protection from labour laws. They also face problems of social integration in Kerala. There are reports of large number of human rights violations. With the possibility of much larger influx in view of the large scale expansion of economic activities in the State, the migrants can put heavy pressure on urban infrastructure, environment and public services. They may also pose many challenges in governance particularly of urban areas.

Migration and regional disparities are strongly interlinked. For the analysis of the same the study brings the relationship between the impact of internal migration on Urbanization by considering socio-economic and migration variables such as Volume of migration and rate of migration

In India, the rank of the population growth was higher in the urban areas than the rural areas. Urbanization is the process of concentration with respect to the size of the urban center. City size represents the number of population in the city. The causes of changes in the city size are random in nature. The city size variable is treated as a stochastic variable. Urban analysis deals with the cities and how the city exists as a single interacting system with respect to spacing size structure.

Migration is a selective process affecting individuals or families with certain economic, social, educational and demographic characteristics. It occurs as a response to economic development as well as social, cultural, environmental and political factors. The socio-economic and demographic implication of rural-urban migration does have significant impact on both rural and urban areas (Lipton, 1980). It is widely recognized that the risky nature of agricultural activities and the difficulties of self-insurance in low income rural settings encourage out-migration as a risk diversification strategy (Stark & Levhari, 1982; Katz & Stark, 1986) the migrants by the family members residing in the rural areas represent a potential means to overcome credit constraints for source

households (Stark & Lucas, 1988).

There are many reasons for migration and immigration. Rural to urban migration can be a selective process, as some types of people are more likely to move than others. Some of the factors involved are; a) *Gender* - because employment opportunities vary greatly with different jobs for men and women. b) *Age* - Young people are more likely to move to towns, with more elderly people and children left in rural areas. If more men move to towns and cities than women, this leaves a predominantly female society in rural areas. c) *Employment opportunities* – These are one of the primary pull factors in cities. Many industries are located in cities and offer opportunities of high urban wages. d) *Increased Educational institutions*- Cities provide courses and training in a wide range of subjects and skills. People are attracted to an urban lifestyle and the 'bright lights' of city life. All of these factors result in both temporary and permanent migration to urban areas. e) *Poor living conditions and the lack of opportunities* in area of origin - for paid employment in rural areas are push factors. People are moving away from rural areas because of poor health care and limited educational and economic opportunities as well as environmental changes, droughts, floods, lack of availability of sufficiently productive land, and other pressures on rural livelihoods. f) Greater access to social services, g) Opportunities for social and cultural activities, h) Better health facilities and i) Better infrastructure facilities.

The theoretical underpinning on the relationship between rural-urban migration and development has its historical roots in the Lewis Model of economic development (Lewis, 1954). This model conceptualized the agricultural sector as being 'traditional' and characterized by a fixed supply of land, little capital, and a large pre-existing supply of labour. The industrial sector was taken to be 'modern' where land was not required as an input and where capital could be accumulated and labour absorbed as needed. The process of economic development was seen as an increase in industrial activity relative to that of agriculture, as with high rates of capital accumulation in the industrial sector, the surplus labour in agriculture is slowly absorbed in industry. Thus, a key prediction of the Lewis model was that rural-urban migration would be primarily driven by the existence of surplus labour in rural areas along with the expanding opportunities of employment for such labour in urban areas.(Dubey, et.al., 2004)

The challenge of managing urbanisation will have to be addressed through a combination of increased investment, strengthening the framework for governance and financing, and a comprehensive capacity building programme at all levels of government. Focussing on the above mentioned areas Government of India had initiated various Urban Infrastructural Development Programmes.

JAWAHARLAL NEHRU NATIONAL RENEWAL MISSION (JNNURM):

In 2005, the GOI launched the JNNURM as the first national flagship program to manage its rapid urbanization. There have been many national urban programs, but the JNNURM was different in its size and modality. The JNNURM allocated more than Rs. 66,000 crores (approximately, USD 11 billion) as central government assistance for a seven year period to support holistic and planned development of 65 cities. The focused objectives of the Mission are: "Integrated development of infrastructure service, Securing linkages between asset creation and maintenance for long-run project sustainability, Accelerating the flow of investment into urban infrastructure services, Planned development of cities including peri-urban areas, out growths, and urban corridors, Renewal and redevelopment of inner city areas, Universalisation of urban services so as to ensure their availability to the urban poor" *(MOUEPA & MOUD, 2005)*

In relation to these objectives, Sivaramakrishnan (2011) raised the question of "whether the JNNURM is a project or a policy response to India's rising and enormously
complex urban problems?", and answered that "the stated objectives do combine both". The JNNURM has been designed as a comprehensive approach covering physical improvement and institutional enhancement for urban development. In relation to the mission objectives, the JNNURM consists of two main parts: Reforms and Projects. Two ministries—the Ministry of Urban Development (MOUD) and the Ministry of Housing and Urban Poverty Alleviation (MOHUPA) are the guiding agencies for JNNURM projects. The project component has four Sub-Missions. The Urban Infrastructure and Governance (UIG) and the Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT) are being managed by the MOUD, and the Basic Services to Urban Poor (BSUP) and the Integrated Housing and Slum Development Programme (IHSDP) are administered by the MOHUPA. The UIG and BSUP are implemented in the 65 selected cities, and the other two Sub-Missions are initiated for other smaller cities.

In the state of Kerala it was Kerala Sustainable Urban Development Project (KSUDP) that acted as the State-Level Nodal Agency (SLNA) for the Urban Infrastructure and Governance components of JNNURM.The Projects were undertaken in the five municipal corporations i.e. Kochin, Thiruvanthapuram, Kollam, Kozhikode

Thrissur. The project components that were considered in the areas were;-Water Supply, Drainage, Sewerage, Solid Waste Management, Road & Transportation

Some issues with JNNURM are: i) **Unsatisfactory Implementation of Reforms**: Less than 3/4th of the reforms were implemented in North East States, Haryana and Bihar; while some states could not even manage to roll out the reforms. Ii) **Slow Progress of Projects:** Overall, only 42% projects were completed under JNNURM (even after extension of deadline by 2 years). Iii) **Narrow Eligibility Condition For Projects:** The eligibility conditions for assistance under the JNNURM were narrow and only 63 cities/urban agglomerations qualified for assistance under the scheme. Iv) **Limited Scope of Modernization:** JNNURM focused upon treatment of sewage and garbage, augmentation of water supply, building roads and flyovers.

The above mentioned reasons as well as the abrupt ending of the project. certain components and their related projects were in a state of limbo that led to the formulation and execution of an extensive and advanced nationwide Urban transformation and rejuvenating programme named AMRUT.

Latest Urban Infrastructure Development Project - Atal Mission For Rejuvenation And Urban Transformation (AMRUT)

Honorable Prime Minister of India cleared that Smart City Mission and AMRUT (Atal Mission for Rejuvenation and Urban Transformation.) for 500 Cities with significant Budget outlays. India's Economy is expanding rapidly and making a steady shift from Rural to Urban. India population is expected to rise 600 Million by 2031

Smart City and AMRUT uses Digital Technology or Information and Communication Technologies to enhance quality and performance of urban Services, to reduce cost and resource consumption, and to engage more effectively and actively with its Citizens. The focus will be on Innovation in Industries, Clusters, Districts of a City, Knowledge Workforce: Education and Employment, Creation of Knowledge-Intensive Companies, Transport, Energy – Utilities, Protection of the Environment – Safety, Administration services to the Citizen, Participatory and direct democracy, Services to the citizen: Quality of life.Main Thrust areas are: Water supply, Sewerage facilities, Septage management, Storm water drains to reduce flooding, Pedestrian, non-motorized and public transport facilities, parking spaces, Green space and parks and Capacity Building. The Districts in Kerala for AMRUT are: Thiruvananthapuram, Kochi, Kozhikode, Kollam, Thrissur, Alappuzha and Palakkad.

OBJECTIVES OF THE STUDY:

1. To Study the Changes made to our city size growth model with respect to the shape.
2. To check that the population density of the city is negatively related with the distance from the center.
3. To check, the city population and the rank of the city are closely related and such a relation is represented by rank size rule
4. To study the urbanization in the areas via JNNURM with respect to the size of the city, and distance from the urban center.

RESEARCH METHODOLOGY :

Cities are defined as the urban localities of size 1, 00,000 or more, medium towns are the places having population between 20000 and 99999 and small towns have population within the range of 5000 to 19999.A variable represents the measurements of certain phenomenon such as city size. Changes in the city size are due to multiplicative factor operating in the city system. The causes of changes in the city size are random in nature. Hence city size variables may be viewed as a stochastic variable or random variable. Population density is defined as number of population per square kilometer in a region. The distance from the center of the city to the place of the city is also called as an independent variable. The population density is a variable(y), which depends on the distance(x).

TECHNIQUES:

In most (but not all) cities, as time goes on, density tends to fall in the most populous inner suburbs, and to rise in the outer suburbs, and the whole city tends to spread itself out. The falling of density, as we proceed to the outer suburbs, follows simple mathematical equations of exponential decline. When x be distance in miles from the city, the density of resident population in thousands per square miles and the model can be expressed as the Negative exponential model, representing the population density is described as, $\mathbf{Y = A\, e^{-bx}}$, x>0, Where x = distance from the centre of the city. Y = population density per square miles. A and b are parameters. Then the

total population within a radius r is (integrate 0 to r) assuming continuity for the total area is $\int_0^r A e^{-bx} (2\pi x) dx$. It has been seen that in each case the data lie approximately along a straight line, expect for the central business zone, where the resident population is always smaller than might have been expected. The value of A is determined from the point at which this line cuts the vertical axis, and the value of b from its slope.

These results do enable us to give a simplified classification of cities and of their trends of growth. If a metropolitan area is to have a high total population, it must either put up with a considerable degree of overcrowding in the inner or it must spread itself out. This is the verbal expressions of the mathematical equation given, spreading out is only possible where transport cost are low in relation to the citizen's income. A city with fairly high transport cost will have a fairly high value of b .Its total population grows, the value of A (degree of overcrowding at the center) must necessarily rise. The other two considerable models are as follows.

Square root Negative exponential model. $\mathbf{Dx = D_0 e^{-a\sqrt{x}}}$ **,**

on logarithmic scale, $\log D_x = \log D_0 + a\sqrt{x}$ by using the following transportation $y = \log D_x$, $A = \log D_0$, $b = a$, $x = \sqrt{x}$ where x is the distance from the center of the city. D_x = population density per square miles.

Rank size model. The rank size model states that the rank of the city when modified by using some exponent and multiply by the size of city is constant which represents the population of the largest city. It describes as, $R^q P_R = C$ Where R = Rank of the city, P_R = population of the city rank R, $C = P_n$ = population of the largest city. On logarithmic scale $q \log R + \log P_R = \log C$, $\log P_R = \log C - q \log R$

Method of least square principles to used the estimated parameters in this model. The principle of least square is used to fit a curve of the form , $Y = F(X_i, a_0, a_1, a_2 \ldots, a_n) + E$, where a**i** 's are unknown parameters to a set of n sample observations (xi,yi) i=1,2,….,n from a bivariate population and E is the error, distributed as $N(0,\sigma^2)$. By minimizing the sum of square of residual, $E = \Sigma \{Y_i - F(X_i, a_0, a_1, a_2 \ldots, a_n)\}^2$ subject to variation in $a_0, a_1, a_2 \ldots, a_n$ and the following normal equation for estimating $a_0, a_1, a_2 \ldots, a_n$ and are obtained. $\delta E/\delta a_i = 0$, i= 1,2,3…n, by solving these equations a_i's are obtained (Table 7 and Table 8). The chi-square test is used to test the goodness of fit of the model to the set of population data.

EMPIRICAL ANALYSIS:

The changes should be made to the city size growth model with respect to the shape. The population (or traffic) density is decreasing while the distance from the center point is increasing. That is why in the Calicut-Mankawu by pass road (The first outer semi-circle) the traffic is more than the new Calicut- Ramanattukara by-pass road, which is made to reduce the traffic of the first. The same proposal, an outer circle road at Bangaluru also is proposed by the authority now with respect to the density.

From Figure 5a. Like Thrissur, Palakkad and Coimbatore city expansion is circular with radius r_1 and then r_2. Towards the centre of the city it is seen that the population density and traffic has an increasing tendency. Also from Figure 5b Cochin, Thiruvananthapuram and Calicut the size of the city expansion is like a half circle since one side of the cities is sea.

That is, we can observe that the expansion of these urban areas are following some geometric format and these characteristics can be confirm by testing the goodness of fit of said shaped suitable distributions.

We can observe that the distance from the centre is negatively connected with the traffic or population density. To test this we make use of some statistical models.

If a metropolitan area is to have a high total population, it must either put up with a considerable degree of overcrowding in the inner or it must spread itself out. This is the verbal expressions of the mathematical equation (2) given in, spreading out is possible only where transport cost are low in relation to the citizen's income.

The distribution of Ernakulum city population with respect to the place and its area are presented in Table 6.The distance from the center of Ernakulum city to the different place are observed and presented here.Here places like Amballur,Puthencruz,Thekkumbhagom & Thiruvankulam are became urban only on 2011. Similarly Alangad, chelamattom, Chengamanad & Chowwara etc. are from 2001 itself urban and Angamaly, Chennamangalam, Edathala & Kochi etc., are since 1991 itself treated as urban.

More than that there is a high positive correlation between the population of these cities at 2001 and 2011. We calculate the Karl Pearson correlation coefficient of them as 0.9969. The line of regression is $Y = 1.011724x + 1629.733$(as $Y = ax + = b$)

We can identify a moderate negative correlation between distances and 2011 population. (Correlation coefficient is –0.5285). Similarly we can calculate the same for at 2001 population as –0.58 and for 1991 as –0.45 respectively.

FINDINGS AND DISCUSSION:

After the initialization and implementation of the JNNURM projects in Kochi in 2005, it can be understood that there has been a marked increase in the population of towns that are approaching towards the center of Kochi, Urban Agglomeration. A marked increase has been shown from 1991 to 2011 in the population index. Currently the execution of the Urban infrastructure development projects through AMRUT is evidently going to trigger the Urban population density which in itself states that such projects are acting as fuel towards the Urbanization of regions in Kerala and the marked after effects shows that the area of the total city is gradually increasing outwards and significantly follows the discussed shape parameters of City Expansion

Using the information in Table 6 the Rank size model, Negative exponential model and Square root Negative exponential model is fitted to the Ernakulum city population. The observed and expected population of Ernakulum city based on logarithmic scale is calculated. The estimates of the parameters (used in finding the expected frequencies of the model (2001&2011) were obtained and presented (Table 7)

The suitability of these models to Ernakulum city population data have been tested by using chi-square statistics. The chi-square values along with inference about the suitability of these models have been completed and presented in Table 8. So the results indicate that these models are appropriate for the study of 'expansion of Cochin city population data'. Rank size model links the distance and population of the city. Also Negative exponential model and Square root Negative exponential model do enable us to give a simplified classification of cities and of their trends of growth.

CONCLUSION:

The study has enabled to understand certain vital aspects of urbanization with respect to the city of Cochin. Since 1991, till 2011 the analysis and evaluation of the Population Census indicate that there has been a rise in the towns and density of population of areas approaching towards the center of the urban agglomeration. Similarly the City expansion is taking place in the outward area. The fitting of probability distribution based on the shape parameters enable many projects for the circular outward expansion scientifically. Hence by using such models can calculate the distance, area and density to be considered in the proposed projects mathematically. The increase in the number of statutory and census towns post JNNURM indicates the fact that urbanization is in the path of progression and the Government initiated programmes are contributing their share towards advancement. Socio – Economic variables that are to be concentrated upon for a sustainable City Development Plan has been chalked out.

Thus Urbanization is the need of the hour but focal points have to be concerted upon for a sustainable progressive development of the city

REFERENCES:

Allen, J. and K. Lu. (2003). Modeling and prediction of future urban growth in the Charleston region of South Carolina: a GIS-based integrated approach. *Ecology and Sociology* 8(2):2. [online] URL: http://www.consecol.org/vol8/iss2/art2/

Dubey, A., R. Palmer-Jones and K. Sen (2004). Surplus labour, social structure and rural to urban migration: evidence from Indian data, *The European Journal of Development Research,* Volume 18, 2006 - Issue 1, Pages 86-104

Gugler, J. (1988). *The urbanization of the third world.* Oxford: Oxford University Press, 421 pp

Joel E Cohen (1995). *How Many People Can the Earth Support?* New York: W. W. Norton. 532-539.

Joel E Cohen (2005). Human population grows up, *Scientific American*, Sept Edn. 48–55

K .Giesen, A Zimmermann & J Suedekum, (2010). The size distribution across all cities-double Pareto lognormal strikes, *Journal of Urban Economics,* 68, 129–137

Katz, E. and Stark, O. (1986). Labor migration and risk aversion in less-developed countries, *Journal of Labor Economics,* 4:134-149.

Lall, Somik V. & Selod, Harris & Shalizi, Zmarak (2006). Rural-Urban Migration in Developing Countries: A Survey of Theoretical Predictions and Empirical Findings. *Policy Research Working Paper;* No. 3915. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/8669

Lewis, W. A. (1954). Economic development with unlimited supplies of labour, *Manchester School* 22: 139–91.

Lipton, M. (1980). Migration from Rural Areas of Poor Countries: The Impact on Rural Productivity and Income Distribution, *World Development*, 8 (1): 1-24

Mukherji and Shekhar (2001). Linkage between Migration, Urbanization and Regional disparities in India: Required Planning Strategies, *IIPS Research Monograph, Bombay*, pp. 1-226

Philippe Bocquier (2004). World Urbanization Prospects: an alternative to the UN model of projection compatible with urban transition theory, www.demographic-research.org, *DIAL, Developpment institutions & Analysis de long terme*

Prasanth Warrier, C.B., & Praseeja, C.B. (2017). A Markov Chain Model for the Demographic Study: A Case Study on Urbanization, *International Journal of Mathematics & Computation,* 28 (4), 21-30

Sivaramakrishnan, K. C. (2011). *Re-visioning Indian Cities. The Urban Renewal Mission,* New Delhi, Sage Publications.

Stark, O. & Levhari, D. (1982). On migration and risk in LDCs'. Economic Development and Cultural Change, 31:191 - 196.

Stark, O., & Lucas, R.E.B. (1988). Migration, remittances and the family. Economic Development and Cultural Change. 36, 465-481.

Woodcock, J.T.(1967). Copper Waste Dump Leaching, Pro. Australia, *Inst. Min, Metal,* pp.47-66)

Figure 1: Kerala Urban population and India Urban Population (in % to the total population)

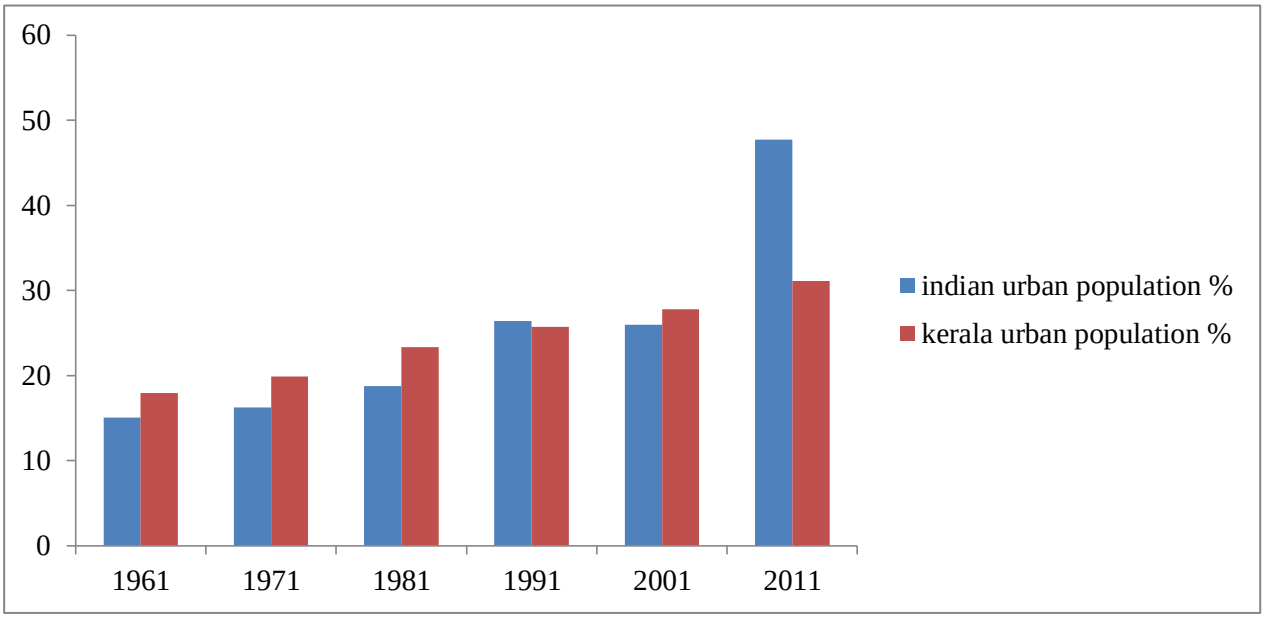

Figure 2: The percentage increase in Statutory & Census towns based on 2001& 2011

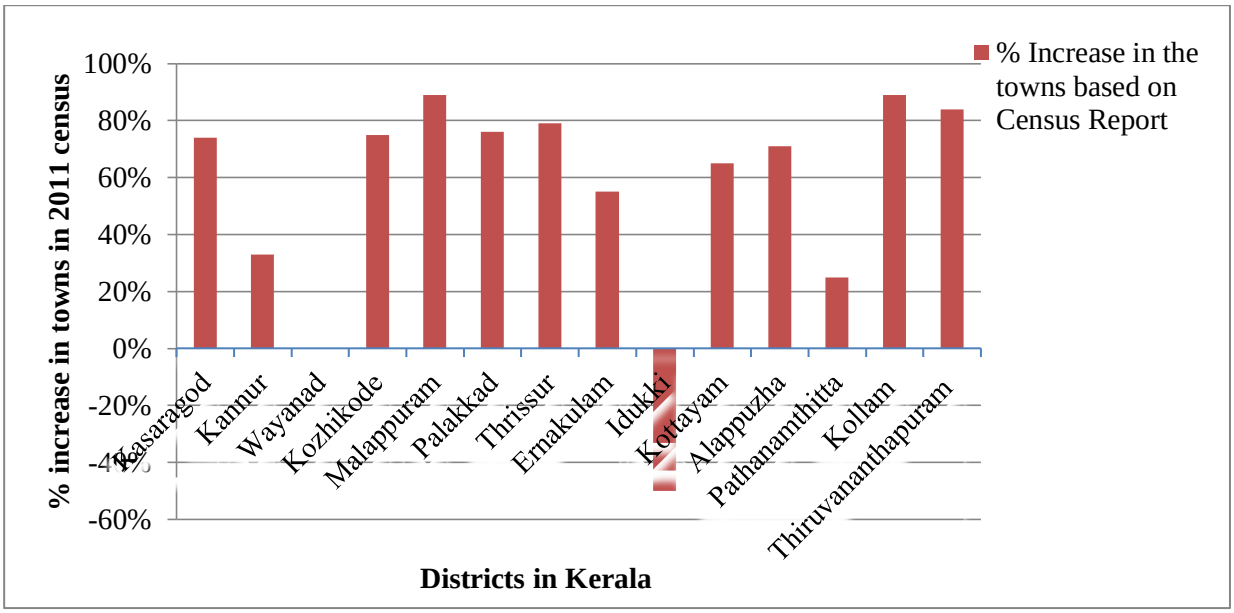

Figure 3: Rural and Urban Populations in 14 districts of Kerala

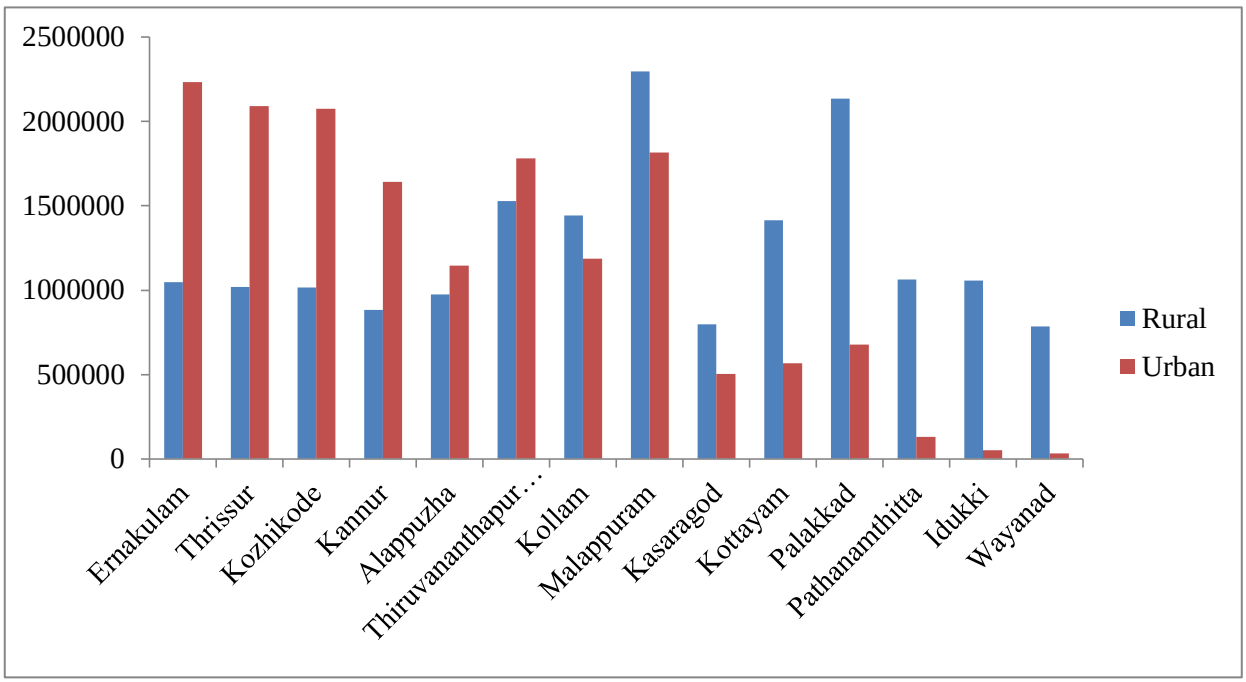

Figure 4: The urban population Growth during 2001 -15

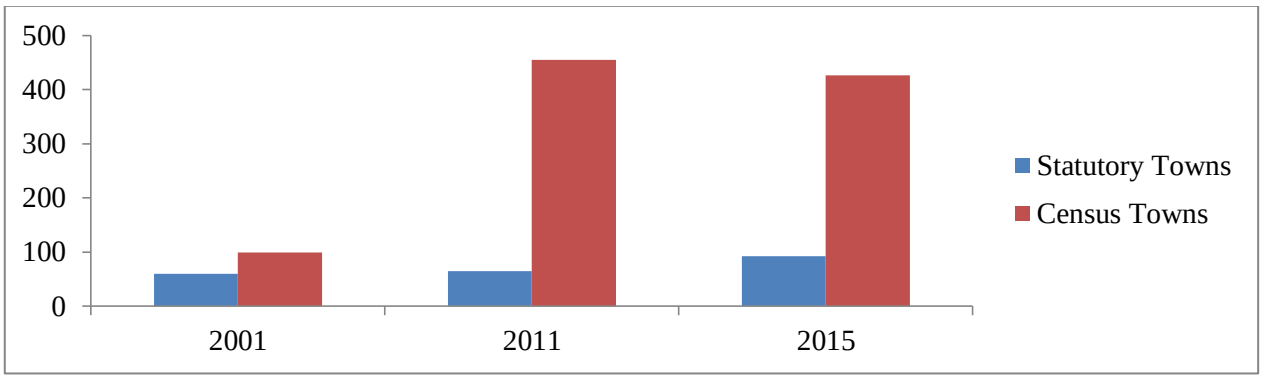

Figure 5a Thrissur, Palakkad and Coimbatore city expansion is circular with radius r_1 and then r_2. Figure 5b Cochin, Thiruvananthapuram and Calicut are semi-circular with radius r_1 (of 2001 population) and then r_2(of 2011 population).

Figure 5a

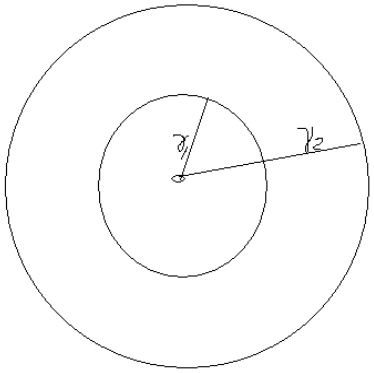

Figure 5b

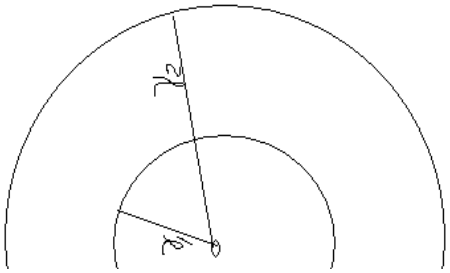

Table 1: The increasing nature of Urbanization in the World

Classification	Year 1950	Year 1990
World	30%	51%
Most Economically Developed Countries (MEDC)	53%	74%
Least Economically Developed Countries (LEDC)	17%	34%

Table 2: Kerala Urban population & India Urban Population (in percentages (%) to the total population) from 1961 to 2011

Year	Urban Kerala - Decennial Growth		Kerala Urban population share	India Urban Population share
	Absolute	%		
1961	728309	39.89	15.11	17.97
1971	912308	35.72	16.24	19.91
1981	1304826	37.64	18.78	23.34
1991	2909019	60.97	26.44	25.71
2001	586631	7.64	25.96	27.8
2011	7665246	93.72	47.72	31.1

Table 3: A comparative Census Analysis of towns based on 2001 & 2011 Census Report

SN	District	2001 Census			2011 Census			% increase in the towns
		Statutory Towns	Census town	Total	Statutory towns	Census town	Total	
1	Kasaragod	2	5	7	2	25	27	74%
2	Kannur	7	38	45	7	60	67	33%
3	Wayanad	1	0	1	1	0	1	0
4	Kozhikode	3	10	13	3	48	51	75%
5	Malappuram	5	0	5	5	39	44	89%
6	Palakkad	4	1	5	4	17	21	76%
7	Thrissur	7	21	28	7	128	135	79%
8	Ernakulam	9	16	25	9	47	56	55%
9	Idukki	2	0	2	1	0	1	- 50%
10	Kottayam	4	2	6	4	13	17	65%
11	Alappuzha	5	6	11	5	33	38	71%
12	Pathanamthitta	3	0	3	3	1	4	25%
13	Kollam	3	0	3	3	24	27	89%
14	Thiruvananthapuram	5	0	5	5	26	31	84%
	Kerala	60	99	159	59	461	520	69%

Table 4: Percentage of Urban Population in Kerala

Rank	Districts	Rural	Urban	Total	% of Urban Population
1	Ernakulam	1047296	2232564	3279860	68.07
2	Thrissur	1020537	2089790	3110327	67.19
3	Kozhikode	1014765	2074778	3089543	67.15
4	Kannur	882745	1642892	2525637	65.05
5	Alappuzha	974916	1147027	2121943	54.06
6	Thiruvananthapuram	1528030	1779254	3307284	53.80
7	Kollam	1443363	1186340	2629703	45.11
8	Malappuram	2294473	1816483	4110956	44.19
9	Kasaragod	797424	505176	1302600	38.78
10	Kottayam	1413773	565611	1979384	28.58
11	Palakkad	2133699	677193	2810892	24.09
12	Pathanamthitta	1064076	131461	1195537	11.00

Rank	Districts	Rural	Urban	Total	% of Urban Population
13	Idukki	1055428	52025	1107453	4.70
14	Wayanad	784981	31577	816558	3.87
15	Kerala	17455506	15932171	33387677	47.72

Source: Census 2001&2011

Table 5: The urban population Growth during 2001 -15

Sl. No.	Towns	2001	2011	2015
1	Statutory Towns	60	65	93
2	Census Towns	99	455	427
3	**Total**	**159**	**520**	**520**

Source: Census 2001 & 2011.

Table 6: Distribution of Ernakulum city population by ranking with respect to distance

Sl No	Name of the place	Area (sq.km)	Distance (kM)	Rank w.r.to distance	Population 1991	Population 2001	Population 2011
1.	Kochi	107.13	0	1	564589	625522	633553
2.	Maradu	12.4	7	2	34995	40,993	44704
3.	Kumbalangy	21.14	7.1	3		40331	42.367
4.	Thrippunithura	29.2	10.1	4	51078	59884	69390
5.	Kumbalam	20.79	12.5	5		27549	29193
6.	Thiruvankulam	10.49	12.7	6	18412	21717	23160
7.	Mulavukad	19.3	13.6	7	22322	22,845	21833
8.	Kureekkad	14.3	14.4	8		9,730	13348
9.	Eranelloor	14	15.2	9		28223	33829
10.	Vazhakkala	12.87	16.8	10	18975	43078	51242
11.	Puthuvype	7.06	17	11			23717
12.	Mulamthuruthy	21.48	17.5	12		23615	25852
13.	Kakkanad	17.54	17.8	13		22486	25531
14.	Manakunnam	24.86	17.9	14		33523	39538
15.	Elamkunnapuzha	8.72	18.5	15		26092	26997
16.	Kanayannur	7.38	19	16		9443	9308
17.	Kadamakkudy	12.9	19.3	17		15,823	16295
18.	Njarackal	8.63	20.2	18		24166	23760
19.	Puthencruz	28.1	20.9	19			22378
20.	Amballur	9.1	22.1	20			11358
21.	Eloor	14.2	22.5	21	34485	30,092	31468
22.	Kunnathunad	17.21	22.8	22		20500	22881
23.	Kalamassery	27	24	23	54342	63,176	71038
24.	Varappuzha	10.01	24.1	24	22514	24,524	26750
25.	Choornikkara	11	24.6	25	34837	36,998	43207
26.	Alangad	18.4	26.4	26		40,585	47329
27.	Aluva	7.2	26.9	27	24,774	24,108	22428
28.	Kadungalloor	18.1	27.5	28	25433	35,451	39666
29.	Kottuvally	20.8	29	29	34457	37,884	42922
30.	Edathala	16	31.4	30	56397	67,137	77811
31.	Chowwara	32.9	32.9	31		13,603	14933

Sl No	Name of the place	Area (sq.km)	Distance (kM)	Rank w.r.to distance	Population 1991	Population 2001	Population 2011
32.	Paravur	9	33.9	32	27906	30,056	31503
33.	Karumalloor	19.01	34	33		26856	29805
34.	Vengola	18.07	34.7	34		26034	32697
35.	Chengamanad	15.6	35.3	35		29,775	29576
36.	Chennamangalam	14.7	36	36	26,825	28,147	29326
37.	Marampilly	9.24	36	37		20071	23272
38.	Thekkumbhagom	6.13	36.5	38			10798
39.	Vadakkekara	6.48	36.6	39		20099	20571
40.	Vadakkumbhagom	7.19	37.9	40		11584	11727
41.	Nedumbassery	19.74	38.4	41		28607	29706
42.	Perumbavoor	28.5	38.5	42	24667	26547	28110
43.	Angamaly	24	38.8	43	30,391	33,424	33465
44.	Velloorkunnam	8.35	39	44		10363	11576
45.	Kizhakkumbhagom	7.13	39.5	45		10038	10791
46.	Muvattupuzha	13.18	40.1	46	27595	29246	30397
47.	Moothakunnam	9.93	40.5	47		27293	27488
48.	Perumbavoor	6.89	41.2	48		8026	9185
49.	Puthenvelikkara	25.51	42.6	49		32213	33372
50.	Kalady	10.32	43.5	50		20407	20380
51.	Koovappady	17.29	43.9	51		26525	39339
52.	Mattoor	9.77	45.6	52		17862	18890
53.	Cheranallur	10.6	46.7	53	21407	26,330	30594
54.	chelamattom	7.29	46.8	54		15,366	16844
55.	Vazhakulam	10.58	49.3	55		14206	18358
56.	Kothamangalam	19.85	53.2	56	35535	37173	38837
	Total				**1191936**	**2025326**	**2244393**

Table 7: Estimate of parameters 2001 and 2011data

Model	Estimates of parameters (2011)	Estimates of parameters (2001)
Rank size model	$P^{\Lambda} = 154.63$, $q^{\Lambda} = -1.35$	$P^{\Lambda} = 163.531$, $q^{\Lambda} = -1.432$
Negative exponential model	$A^{\Lambda} = 2016$, $b^{\Lambda} = 0.0512$	$A^{\Lambda} = 2011$, $b^{\Lambda} = 0.0621$
Square root Negative exponential model	$D_0 = 6273.81$, $q^{\Lambda} = -0.5418$	$D_0 = 6093.81$, $q^{\Lambda} = -0.603$

Table 8: Chi-square values. (Based on 2011population)

Model	Chi-square values(2011)		Chi-square values (2001)		Chi-square table $\alpha = 0.05$ degrees of freedom 51
	Calculated	p-value	Calculated	p-value	
Rank size model	27.9	0.9965	14.5	0.99783	68.669
Negative exponential model	3.69	1.0	2.7	1.0	68.669
Square root Negative exponential model	4.527	1.0	4.15	1.0	68.669
