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Human Pressure on Land – The Changing Case of the Thiruvananthapuram District of Kerala

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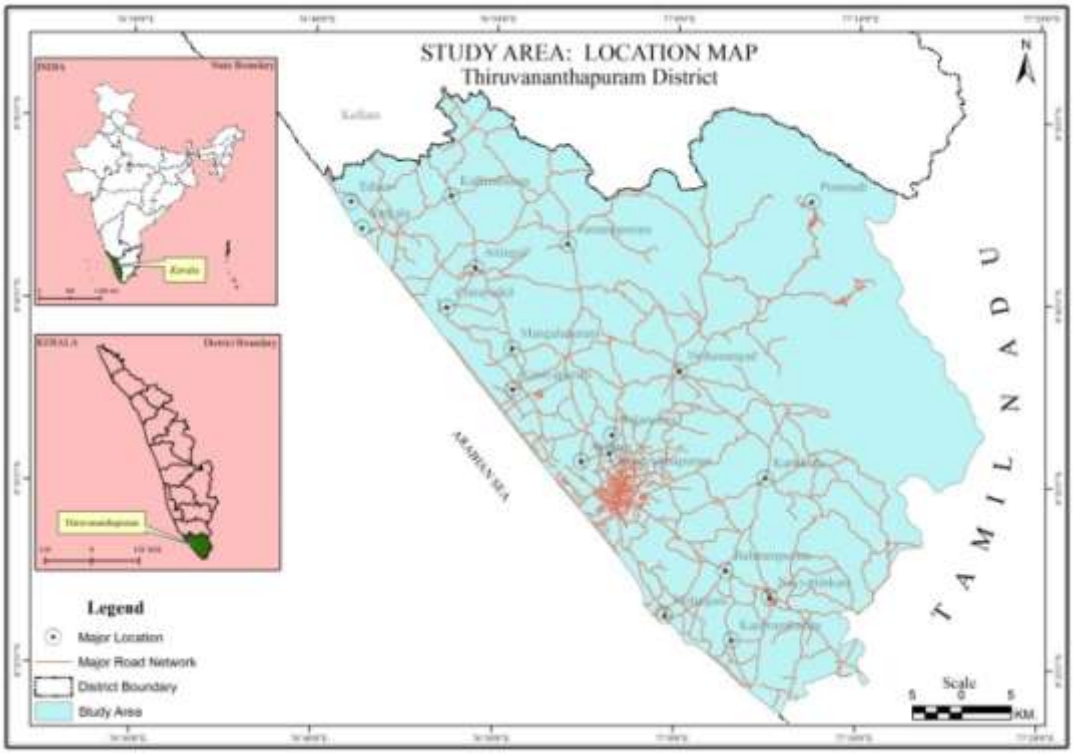
Abstract: ***Assessing the human pressure on land is an important parameter for establishing sustainable development plans. Population density, distribution, and growth, man-land ratio, household density, occupational structure, urbanization and land use pattern and its changes are the important parameters that can be used to identify the human pressure on the available land. This study is based on the situations of Thiruvananthapuram, the Capital district of the state of Kerala. Data sources used are mainly secondary like census reports, Survey of India [SOI] Topographical maps, and Satellite imageries. The study showed that the total population of the district is increasing along with the density of population which results in a declining man-land ratio. As a result the household density is also accelerating. The changes in the agriculture oriented occupational structure promote rapid urbanization thereby increasing the human pressure. Land use pattern and its changes is the best indicator for identifying the nature and extent of human pressure on land and also support the argument.***

Keywords: Thiruvananthapuram, SOI, man-land ratio, urbanization, land use

1. Introduction

Land and the uses of land provide a key link between human activity and the natural environment [Winter Michael, 2009]. Land use is one of the best indicators for assessing the human pressure on land. There is often conflict between competing uses of land [Davis, 1976]. These land use changes has received lots of attention internationally [Turner II B.L, et.al, 1994] because land use is the most pervasive socio economic force affecting the process and functions of ecosystems [Marland et.al, 2003]. Over one third of the terrestrial surface has been substantially altered by human land use practices [Vitousek PM, 1994]. This growing and often disorderly use of the earth's resources has begun to be a source of anxiety in recent years [Land use policies and Agriculture, 1976]. With the rapid rise in human population, human induced changes in land use form an important component of regional environmental change [Turner II B.L, et.al, 1994]. As a result of population growth, urbanization and its associated infrastructural development will increase that eventually causes the conversion of more rural landscape, decline in natural vegetation, wild life habitats, and agricultural land [Boka Mustafa et.al, 2007]. Thiruvananthapuram district is the southernmost district of the state of Kerala and is experiencing high degrees of urbanization, land use changes and human pressure on land in the recent decades.



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2. Methodology

Study Area Description

Thiruvananthapuram, the capital district of the state of Kerala, has a favourable geographical location with Arabian Sea on the west and the Western Ghats Mountains on the east that block the moisture laden Monsoon winds and causes heavy rainfall. The district extends from north latitudes $8^0$17'27" to $8^0$51'41" and east longitudes $76^0$40'25" to $77^0$17'06" and incorporates 2189 square kilometres of area. Thiruvananthapuram district stands 11^{th} in area among the districts of the state of Kerala and incorporates nearly 5.64% of its total geographical area. The district experiences heavy rainfall during the monsoon months and the rest of the year are more or less dry. Due to heavy rainfall most areas of the district are covered with lateritic soils. Nearly 32% area of the district falls in the altitude zone ranging from 20-60 meters above mean sea level followed by 23% area in the zone 60-100 meters. The district has predominantly a gentle slope which covers nearly 75% of its area.

Methodology

The present study is solely based on secondary data sources. All the population data are obtained from the District Census Handbook published by the Directorate of Census Operations, Kerala. Land use data are prepared from Survey of India (SOI) Topographical Maps and satellite images. Land use maps were prepared for three different periods; 1967, 1991 and 2017. SOI Topographical maps of 1967 were utilized for preparing the land use maps of 1967. Land use map for the year 1991 was prepared from SOI Topographical maps of 1:25000. Landsat 8 OLI images for the year 2017 were downloaded from Earth Explorer and were incorporated in the ArcGIS 10.0 platform to prepare the land use map of 2017. Supervised classification technique was used for image classification. The study area has been divided into nine land use categories namely built up lands, forests, grass, paddy fields, scrub land, settlement with mixed trees (SMT), wasteland, sandy area and water body

3. Results and Discussion

Human Pressure on Land

- **Population Density, Distribution and Growth**

The total population of the district was only 484493 in the year 1901 which rose to 1327812 in 1951 and 3301427 in 2011. Thus there occurred an increase of 581% in the total population of the district during the last 100 years. On the other hand the density of population of the district increased from 165 persons/square kilometre in 1901 to 1508 persons/square kilometre in 2011 and constitutes the most densely populated district of the state of Kerala. The density of population of the district is increasing year by year at an unprecedented rate.

Density of Population [in persons/sq.km] of Kerala and Thiruvananthapuram District 1901-2011

Year	Density in Kerala	Density in Thiruvananthapuram district.
1901	165	221
1911	184	260
1921	201	304
1931	245	391
1941	284	463
1951	349	606
1961	435	796
1971	549	1003
1981	655	1184
1991	749	1344
2001	819	1476
2011	860	1508

Source: Compiled from District Census Handbooks [DCH] of Thiruvananthapuram 1971-2011

One relief from this abruptly increasing population density is the gradually declining growth rate that the district is currently experiencing. During the period 1901-1911 the district witnessed a population growth rate of 17.54% which increased to the ever highest growth rate of 31.38% during the period 1951-1961. Thereafter it shows a decreasing trend and finally reached at 2.07% in 2011.

- **Man – Land Ratio.**

The various indices to measure man – land ratio and pressure of population on land are crude or surface density, rural density, man-soil density or physiological density, and nutritional density or man-cropland ratio [Singh Jasbir et.al, 2004]. The crude density of the district was 769 persons/square kilometre in 1961 which increased to 1344 persons/sq.km in 1991 and 1508 persons/sq.km in 2011. This means that the total population of the district is increasing year by year without a net increase in the total land area. Thus the per capita availability of land is decreasing which results in very intensive use of the available land that may lead to serious environmental problems like land degradation and water quality deterioration.

The physiological density is a measure of the total population and the total cultivated area. It is also showing an increasing trend. It was 1449 persons/sq.km. of cultivated area in 1971 which rose to 2273 persons/sq.km in 2001 and 2525 persons in 2011. This decrease in physiological density has two dimensions in the district;

1) The population of the district is increasing; and
2) More and more rural agricultural land is now being converting to urban built up area.

Thus, the rising human population exerted a tremendous pressure on the available cultivated area for food. This resulted in agricultural intensification and eventually leads to land degradation.

- **Occupational Structure**

The occupational structure is a major criterion influencing the extent of human pressure on land. As far as the numbers of people engaged in various economic activities are concerned, the cultivators, agricultural labourers, and household industry workers are decreasing in the district. In

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1971, the cultivators and agricultural labourers together constituted 44% of the total workforce. At the same time the household industry workers accounted for 5.3%. On the other hand the other workers including workers in mining & quarrying, workers in industry, construction, trade & commerce, transport, storage & communication and other services constituted 50.7%. The scenario has changed in 2011 with the largest reduction in the category of cultivators and agricultural labourers which together represents only 10.8% as against the 44% of 1971. The proportion of other workers marked a tremendous increase and it has reached 87% in the district in 2011.

This shift in the occupational structure of the district can be related to land use change and land conversion because the increase in the number of other workers and a reduction of people in cultivation and agricultural activities favour urbanization & infrastructural development. In other words it can be stated that these shifts in occupational structure is an indicator of large scale land use changes. Although there is an increase in the number of total workers, the percentage share of cultivators, agricultural labourers, and household industry workers are showing a declining trend. On the other hand the workers in secondary & tertiary sectors of the economy are increasing decade by decade. This indicates a shift from a purely agrarian economy to an urban industrial and service economy. This shift can act as a catalyst for accelerating land use changes. The increasing trend of land conversion in the district can be thus correlated with the changing occupational structure.

- **Household Density**

The number of households in the district is gradually increasing with population growth. As per the 1971 census the district had a total of 388328 households. It increased to 847287 marking an increase of 118%. At present Thiruvananthapuram district has the largest number of households among the districts of Kerala [District Census Handbook, 2011].

Thiruvananthapuram District – Household density

Year	Thiruvananthapuram district	Rural	Urban
1971	388328	293351	94977
1981	491081	370908	120173
1991	619558	413655	205903
2001	759382	505653	253729
2011	847287	390963	456324

Source: Compiled from DCH 1971-2011

The number of households in the district is increasing year by year as a consequence of rising population and the breakup of joint family system. The accelerated urbanization characterising the district enabled the urban areas to have more households than its rural counterpart. In 1971, the district had a household density of only 177 households per square kilometre of area. It reached 224 in 1981 and 283 in 1991. At present the district's household density is 387. This increased household density is compensated by the increased conversion of agricultural/forest/wetland/fallow land to built up areas. By filling the previously occupied farmland or forest areas people are now making more buildings. This is an inevitable consequence of the fast growing urbanization in the district. The breakup of joint families into nucleated one results in an increase of the number of households which results in the fragmentation of existing land and land conversion. In Thiruvananthapuram district the urban household density is growing faster than the rural one. In 1971, the rural & urban household densities per square kilometre of area were 144 and 611 respectively. It rose to 263 in rural areas and 790 for urban areas. As a result of the increasing household density in the peripheral areas of the urban environment, more and more rural areas will be converted into the urban sites in the near future. This resulted in the growth of urban areas and metropolitan cities at the expense of rural agricultural sites. That means the rural areas may become the sacrifice zones for the expansion of the urban built up lands.

- **Urbanization**

The rate of urbanization is increasing in the district where more than half of the total population is now urban. In 1971, only 26% of the population of the district had an urban way of life when the district occupied 155.5 square kilometre of urbanized area out of the total area of 2192 square kilometre. At that time the district had only 10 towns. The total urbanized area increased to 258 square kilometres and the urban population crossed 34% of the total population in 1991.

Thiruvananthapuram District – Rate of Urbanization

Year	Urban population	Urban area in sq.km.	% of the Urban area to the total area	% of the urban Population to the total population
1971	571566	155.5	7.1	26
1981	655761	165.5	7.5	25.2
1991	998243	257.5	11.7	33.8
2001	1091661	271.1	12.3	33.7
2011	1771596	577.5	26.3	53.6

Source : Compiled from District Census Handbooks 1971-2011

There was a tremendous increase in both the total urban area and urban population in the district during the period 2001-2011. During this period the total urban area doubled from 271.1 square kilometres to 577.5 square kilometres. For the first time in the history of the district the total urban population exceeded the total rural population during the same 2001-2011 period. There was also an abrupt increase in the number of towns as it increased from only 10 in 2001 to 31 in 2011. This accelerating rate of urbanization may lead to serious urban ecological problems, biodiversity loss and changes in urban micro-climate. The involvement of more people in secondary and tertiary activities will accelerate urbanization in the coming years and thus will pave way for raising the human pressure on land.

- **Land Use change**

The pattern of lands use in the district is changing to satisfy the changing needs of the people in a changing situation. The most dominant land use category in the district is settlement with mixed trees [SMT] that accounts for 61%. As far as SMT is considered there is not much change in the aerial coverage of this particular land use category since 1966. The noticeable gain happened in the total coverage of the built up land which has risen from 1.5% in 1966 to 2.30% in 1991 to 13 % in 2017. This much increase in the

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built up land has occurred as a consequence of swift urbanization, changes in the occupational structure and the accelerating economic prosperity of the district. But this change is negatively reflected in the aerial coverage of forest, and paddy fields which have lost considerable area as a result of the encroachment of built up lands.

Thiruvananthapuram District, Land use [in %] – 1966-2017

Land use category	Period		
	1966-67	1991	2017
SMT	61	65	61.1
Built up land	1.5	2.3	12.5
Paddy	10.00	7.4	2.5
Forest	22.5	20.40	15.28
Scrub land	0.10	0.80	5.8
Grass land	0.30	0.10	0.02
Waste land	1.1	1.00	0.90
Sandy area	1.00	0.90	0.30
Water body	2.5	2.10	1.6
Total	100.00	100.00	100.00

Source; Compiled from SOI Topographical maps and satellite images.

Paddy lands constituted 10% of the total area of the district in 1966 but declined to 7.4% in 1991 and 2.5% in 2017. Most of the district's paddy lands wee first transformed into coconut and tapioca areas then into settlements. This means that the conversion of paddy fields into settlements takes place step by step. This has resulted in agricultural intensification in the existing paddy lands and now the district is depending more on other districts and states for getting rice. It is now becoming more a consuming district than a producing one.

The most environmentally viable land use category; forest is also facing the threat of transformation in the recent decades. 22.5% of the forest cover of 1966 has reduced to 20.40% in 1991 and finally 15.28% in 2017. All these transformed areas are now occupying rubber, plantations and settlements. People often clear these marginal areas for agriculture and housing. Besides built up land, scrub area is also showing positive trend of areal increase. In 1966 only 0.10% of the district's area was covered with scrubs but it rose to 5.8% in 2017. All other land use types like grass, wasteland, sandy area, and water body are declining in their areal coverage. Ponds, lakes, and rivers are shrinking due to human encroachment for settlements and agriculture. By filling wetlands they are making human imprints on the natural environment.

The total population in the district is increasing with a net increase in the density of population. The highest density of the district among the districts of the state clearly shows the existing and increasing human pressure on available land. Man-land ratio, a typical indicator to assess human pressure on land, is also showing a decreasing trend in the last decades. As a result of the rise in net population the household density per square kilometre of area is increasing which exert a huge pressure on the environment. These factors together accelerate urbanization and now Thiruvananthapuram is one of the most urbanized districts of the state. The existing land use pattern and its changes during the last four decades also show the changing human pressure on the land.

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