

# An Analysis of the Distribution of Healthcare Facilities, the Population, and the Health Workforce in the Kasaragod District on a Taluk-By-Taluk Basis

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## ABSTRACT

**Background:** The spatial distribution of health care services in the Kasaragod area in relation to the regional population is emphasised in this study. A society's progress towards human development can be seen in the advancement of its improved health care system, educational system, and long-life expectancy. By examining the quantity of healthcare facilities and the healthcare workforce it can be seen that the Kasaragod district's healthcare system has not advanced.

**Methods:** The approaches utilised here to understand the deficiencies of healthcare in general are Location Quotient, Equal Count, Logarithmic Scale Method, Percentage, etc.

**Result:** This analysis demonstrates that there are not enough healthcare facilities and health workers in this district depending on the population. The research of the location quotient reveals that the taluks of Vellarikund and Manjeshwaram have fewer medical facilities. But Hosdurg and the Kasaragod taluk have a concentration of healthcare facilities. There are numerous multispecialty hospitals in Mangalore, Karnataka. Manjeshwaram Taluk, which is adjacent, offers subpar medical services.

**Conclusion:** The entire community in Kasaragod district is pleading with the government for medical development, including the establishment of AIIMS hospital and the prompt completion of the building and operation of the medical college, due to the shortcomings of the healthcare system in this area. The government should grant this community's need for justice and sanction it in order to enhance society. For flourishing the society, the government must grant this community's reasonable needs and acknowledgment.

**Key words:** spatial distribution, health care facility, Location quotient, Density, Logarithmic scale method.

## 1.INTRODUCTION:

Medical geography is the study of how geographic elements, such as climate, environment, or location, affect human and community well-being as well as illness. Since 2016, the healthcare sector in India has expanded at a Compound Annual Growth Rate of over 22%. It is anticipated that at this rate, it will reach USD 372 billion in 2022. In terms of income and employment, the healthcare sector has grown to be one of the biggest in India.

People are compelled by demand to look for services that they can afford and are ready to pay for. The care that medical professionals consider necessary for a person to remain healthy or healthy is known as the need for healthcare. Insufficient funding for basic research, a lack of qualified medical personnel, inadequate quality control, insufficient health spending, and inadequate access to basic healthcare services. The administration's insufficient money allocation is one of the main issues. The

following are the factors affecting the health care system.

### **1.1. Social factors**

The non-medical elements that affect health outcomes are referred to as social determinants of health (SDH). In addition to the larger group of factors and systems influencing the conditions of daily life, these are the circumstances in which people are born, develop, work, live, and age.

The health of an individual and society is influenced by a variety of social factors in addition to genetics and lifestyle choices. Up to 40% of what keeps us healthy is attributed to social variables like housing, social relationships, money, and education.

### **1.2. Political factors**

Politics-related factors that could affect healthcare include changes to tax laws, consumer protection and employment restrictions, and insurance mandates. The phrase "quality of healthcare services" refers to a wide range of elements, including the scope of medical services provided, staff clinical competence, hospital amenities, physician expertise, hospital ambience, staff behaviour, in-patient experience, and, most importantly, patient satisfaction. Each of the aforementioned elements plays a crucial role in the overall "quality of healthcare service" and cannot be disregarded in any manner. To provide the highest possible standard of medical care, every hospital needs to pay close attention to each of these specific factors.

### **1.3. Economic factor**

Factors that are social and economic include things like income, education, work, neighbourhood safety, and social support. Social and economic considerations have an impact on the options that are available in a society. These options include our capacity to pay for housing, healthcare, and stress management.

The phrase "health care economics" is used to refer to a variety of elements that interact to affect the expenses and spending of the healthcare sector. Health economics is significant because it focuses on how stakeholders' and recipients' economic

choices impact the standard and cost of medical care. It covers how people pay for care, how payments are handled, and how health systems around the world might be reorganised and enhanced.

### **1.4. Cultural factor**

In order to improve health and prevent and treat diseases, people's cultural beliefs, attitudes, and behaviours, as well as their history and therapeutic practises, are crucial factors.

Lack of exercise, a poor diet, environmental problems, and congenital flaws all contribute to ill health. Age, sex, family health history, lifestyle, and other characteristics are all personal health risk factors. Some risk factors, including genes or ethnicity, cannot be changed. Others, like food and exercise, are under control.

Not just the absence of illness or disability, but also total physical, mental, and social well-being, is referred to as being in good health. Every human being, regardless of ethnicity, religion, political beliefs, economic situation, or social standing, has the fundamental right to the enjoyment of the highest degree of health that is reasonably practicable.

When the body's normal metabolism is disrupted or impaired by a pathogen, a pollutant, or another factor, a health issue—also known as a disease—occurs. These problems can occasionally be hereditary, in which case the patient may get the condition from their parents by inheriting a particular gene. A balanced diet, frequent exercise, work, rest, and optimistic attitude are the cornerstones of good health. The following nutrients are found in a balanced diet: water, carbs, lipids, fibre, minerals, proteins, and vitamins.

The ultimate purpose of health education is to advance, preserve, and enhance the health of both the person and the community. The goal of health education is to lower morbidity and mortality from treatable conditions. Making educated decisions and persuasion are crucial components of health education strategies.

Health, commonly referred to as the "health triangle," is defined by the World Health Organisation (WHO) as the harmony of mental, bodily, and social well-being. Living a healthy lifestyle requires striking a balance between these three categories.

### 1.5. Religious factor

Religion can aid in the healing process by offering tranquillity and hope when healing does not take place, endurance for the road of gradual recovery, and miraculous healing by the divine. Discipline and engaging in some practises, such as fasting, can be beneficial to health.

Attending religious services has been linked to lower levels of several risk factors for ill health and mortality as well as lower prevalence and incidence of sickness and mortality in numerous studies.

The idea of "access" to health care resources is broad and has many different definitions. It has four key dimensions: availability, accessibility, affordability, and acceptability. Many people have mistakenly associated accessibility with having physical or geographical access to healthcare, but others have defined it as the capacity of an individual to use healthcare when necessary, and still others see "access" and "use" as synonyms. When health care services are made available, it's sometimes assumed that access to care will follow organically. However, a large body of research pertinent to South Asia shows that access to health care services does not always follow availability for many segments of the population.

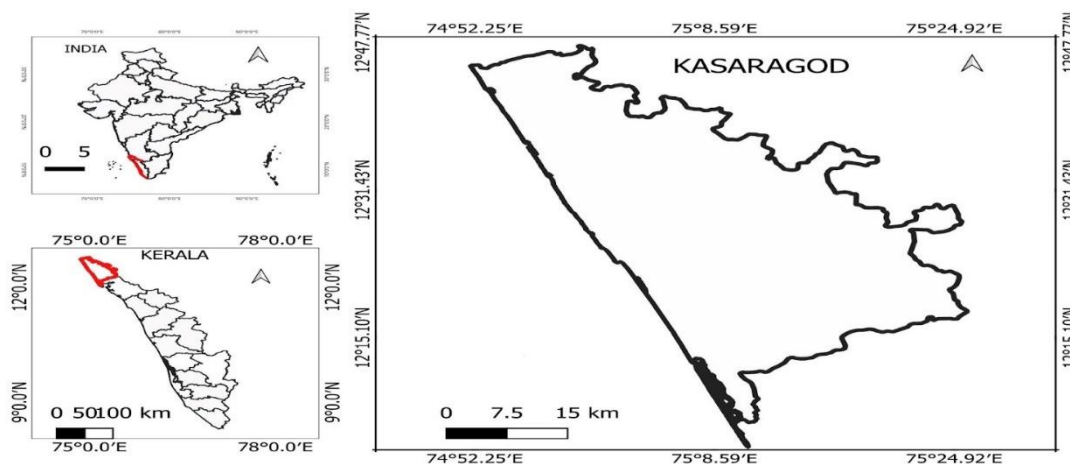
## 2. The Study Area

### 2.1. Geographical Location:

The latitude of Kasaragod is 12.5102239 and the longitude is 74.9851678. Kerala is situated in the nation of India, on the continent of Asia. Latitudes are 8°.17'.30" N and 12°. 47'.40" N and east longitudes 74 ° .27'.47" E and 77°.37'.12" E. The Kasaragod district in Kerala, India, is the research region. Kerala is a southwest Indian state comprising 14 districts, the most northern of which, Kasaragod, shares a border with neighbouring Karnataka. The total area of Kasaragod district is 1992 sq km. On the eastern side, the Western Ghats, which form an almost continuous mountain wall and run parallel to the sea, separate the district from neighbouring areas beyond the state.

Overwhelming the topography are the Ghats. Depending on the prominent physical characteristics, the district can be divided into three natural regions: the lowland, which borders the sea, the midland, which is made up of an undulating landscape, and the forest-covered highland in the far east. Generally speaking, there are four different types of soil: sandy, sandy loam, laterite soil, and hill or forest soil. Along the western coast, there is a continuous, 20 km wide thin strip of sandy soil and sandy loam soil.

### LOCATION MAP OF THE STUDY AREA



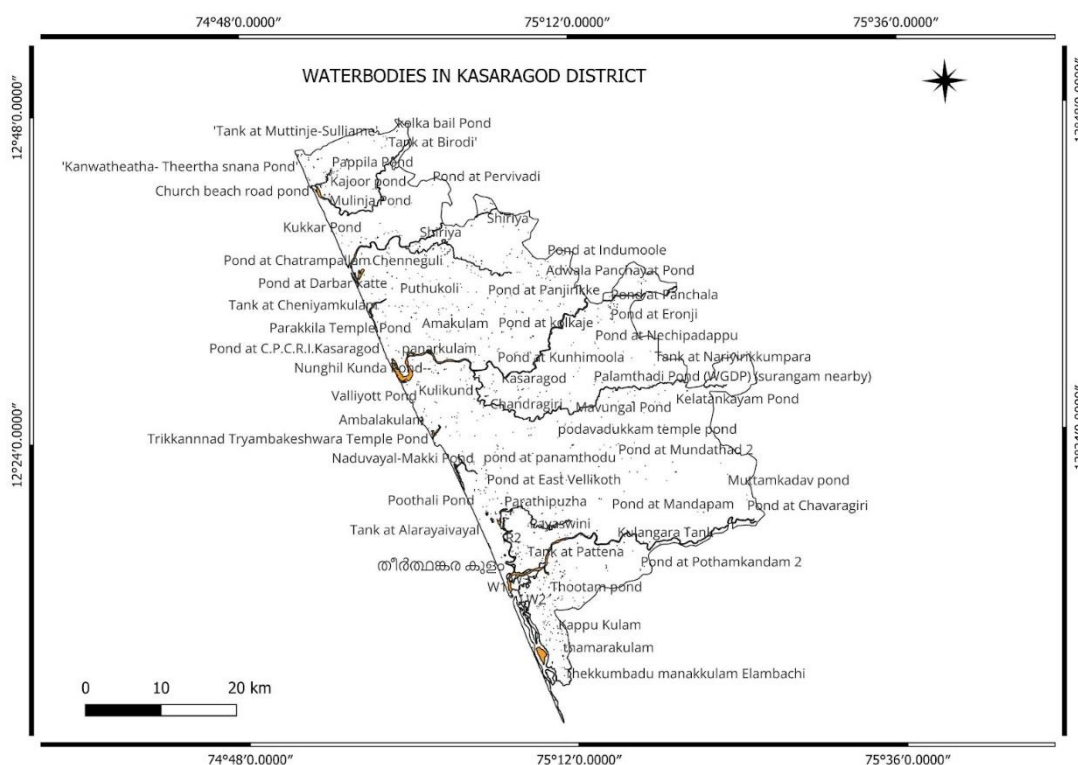
[SOURCE: CREATED BY AUTHOR USING GIS SOFTWARE

### 2.2. Rainfall and Climate:

According to Koppen and Geiger, Kasaragod has a tropical monsoon climate (Am). The Kasaragod district experiences high humidity and a high annual rainfall rate, with an average temperature of 28 degrees Celsius. The district receives 3350 mm of rainfall on average each year. The wettest month is July, with 1073.66mm of rain. Each year, there is about 2746 mm/ 108.1 inch of precipitation.

### 2.3. Suranga water source:

Surangas are still one of the Kasargod district's older, less well-known, and swiftly disappearing traditional water collection technologies. Surangas can be compared to a horizontal well or cave that has been dug out of a hard laterite soil formation. Water seeps out of the well or cave and runs out of the tunnel into open ponds. Many farmers in Kasargod still rely on surangas to provide them with drinking water, despite the fact that they are in decline.



[Source: created by Author using GIS software]

### 2.4. Rivers in Kasaragod district:

Name of river	Place of origin	Length in km.	Total Navigable
1. Manjeshwar	Kadandur Hills	16	3
2. Uppala	Kudipadi Hills	50	—
3. Shiriya	Kanakad Hills	61	5
4. Kumbla	Yedanad	11	3
5. Morgal	Kanlur Village	34	—
6. Chandragiri	Patti Forests	105	13
7. Kalnad	Chettianchal	8	—
8. Bekal	Kaniyadka	11	—
9. Chittari	Kundiya	25	—
10. Nileswar	Kinanur	47	11
11. Kariangote	Padinalkad	64	24
12. Kavvayi	Cheemeni	23	10

(Source: Kasaragod - Wikipedia)

The longest of the abovementioned is the Chandragiri River, which flows for 105 km from Pattimala in Coorg to Thalagara, where it meets the sea. It's 1250 sq. km. The catchment area receives more than 3 billion cubic metres of runoff annually. There are many tributaries that flow into it, but the two largest ones are Payaswini and Chandragiri.

### 2.5. Agriculture:

Kasaragod is home to a number of horticulture crops. The defining characteristics of agriculture and horticulture are crop diversity and cultivation heterogeneity. Coconut, cashew, paddy, rubber, arecanut, and pepper are among the primary crops grown.

### 2.6. Historical Aspects:

The word "kasaragod" comes from the word "kusirakood," which means "Kanjirakoottam" (Kanjiram Trees/ NuxVomica). Another one is that it is a fusion of two Sanskrit terms, kaasara (lake or pond) and kroda (a location where treasure is held). The Kasaragod district, in Kerala's northernmost region, was established on May 24, 1984. The district was established in

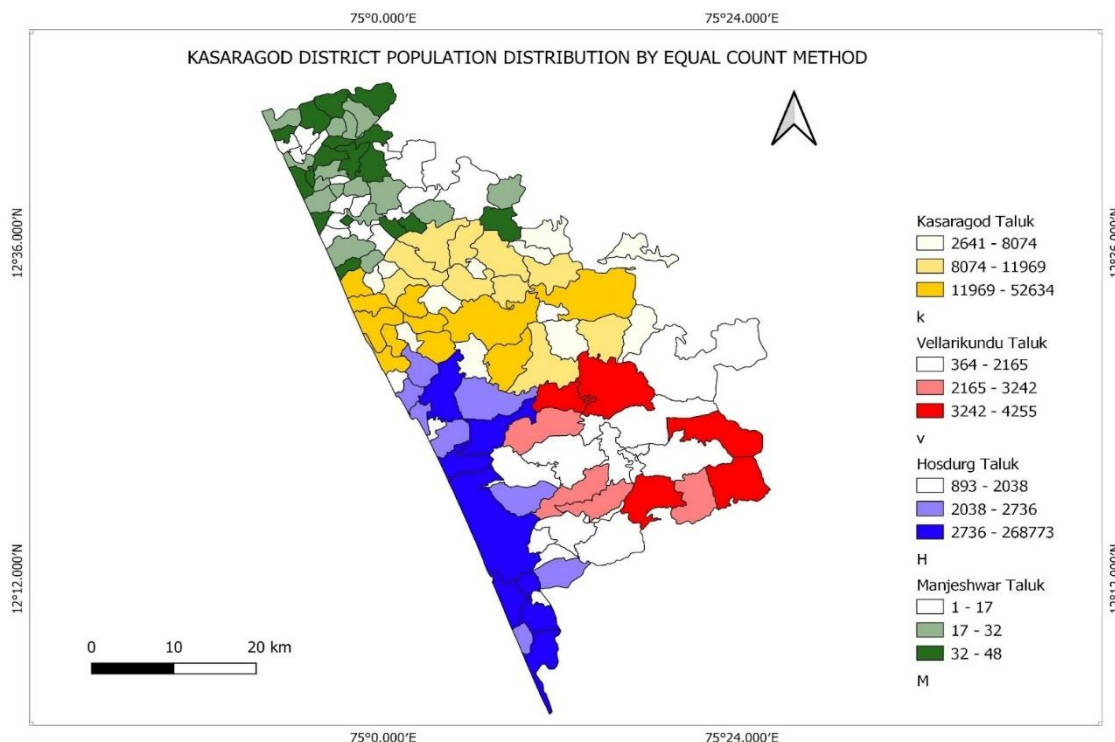
accordance with the GO (MS) number 520/84 / RD order from May 19, 1984.

### 2.7. Administration:

There are 2 revenue divisions, 4 taluks, 6 blocks, 38 panchayats, 3 municipalities, parliament constituencies 1, assembly constituencies 2 and 128 villages in it.

### 2.8. Demography of Kasaragod:

The actual population of the district is 1307375 in the 2011 census, 3.91% of the proportion of Kerala population. In 2001 the actual population was 1204078, in the 1991 census it was 1071508. An increase in the total number of people is referred to as population growth. The population growth in 2011 is 8.58%. The number of individuals residing per square kilometre is used to represent population density. In the 2011 census the population density was 657. In the context of demography, the male to female population ratio is known as the human sex ratio. In the 2011 census the sex ratio was 1080 females for 1000 males. Literacy means the person has the ability to read, write and to solve simple arithmetic problems.



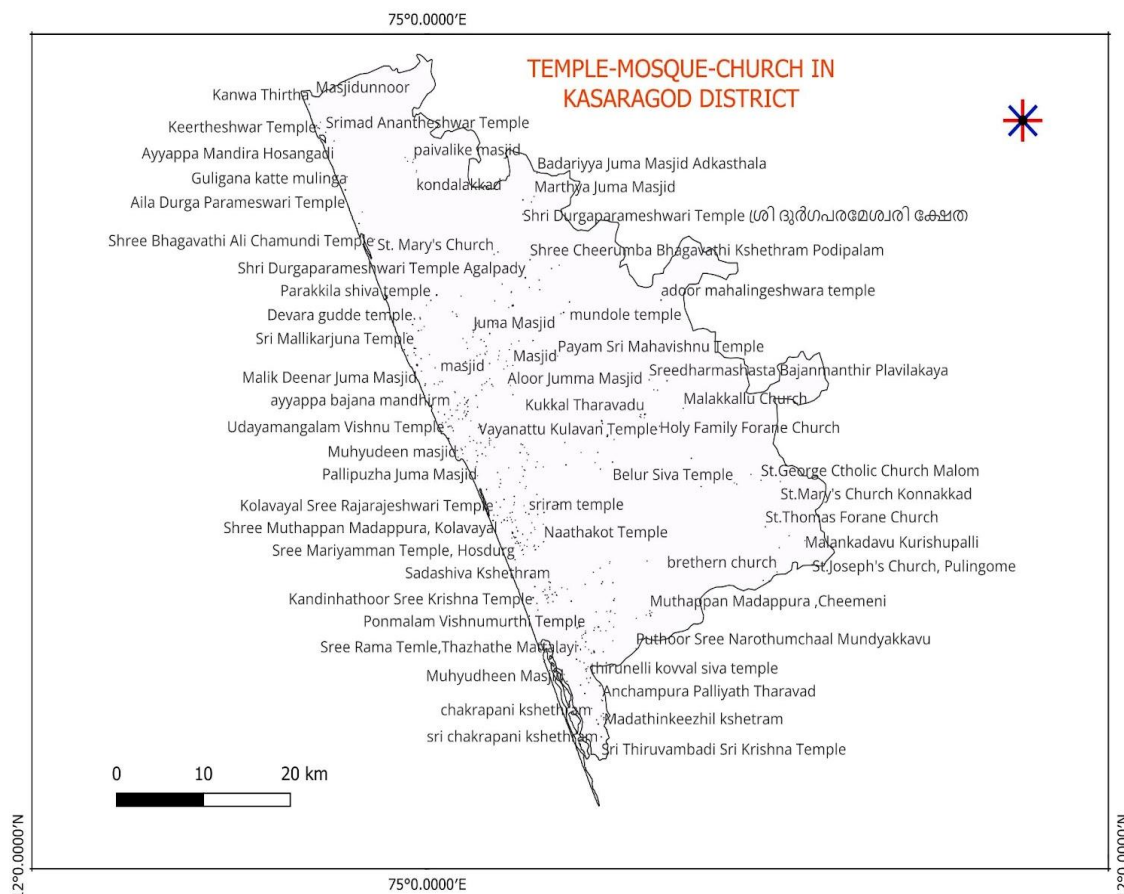
[SOURCE: CREATED BY AUTHOR USING GIS SOFTWARE]



## 2.9. The Culture of Kasaragod:

The cultures of Kasaragod are harmonious with those of the Hindu, Muslim, and Christian religions. In Kasaragod, Hindus, Muslims, and Christians coexist in harmony while embracing one another's cultural

traditions. Kasaragod has a vibrant folk arts, visual arts, and festival scene. Yakshaganam, Theyyam, Oppana, Mappilapattu, Daffmuttu, and other prominent art forms can be found in Kasaragod. The buffalo race is held here as a special occasion.



## 2.10. Transportation facility:

The district has good access to both trains and roads. The district's railway line is 116 km long and runs through the coastal plain. State highways are 141.71 kilometres long, important district roads are 1303.049 kilometres long, and other district roads are 527.11 kilometres long. From Cheruvathur to Talappadi, the National Highway-NH-17, currently known as NH-66, traverses through the district. It is approximately 85.9 kilometres long. The district's road network is supported by the highway, which runs from Talappadi to major towns. The closest airports are at Karnataka's Mangalore, Kannur and Kozhikode International Airport,

each of which are 50, 100 and 200 kilometres from Kasaragod, respectively.

## 3. OBJECTIVES:

1. To identify the villages with the highest population densities and use GIS to measure the distribution of population density by taluk.
2. By contrasting the spatial distribution of the health care system with the density of the population.
3. To evaluate the district's public health workforce size with graphical representation.

#### 4. MATERIALS AND METHODS

1. The construction of the maps showing the distribution of density by taluk was examined using GIS software's Equal Count, Logarithmic Scale Method.
2. Using the formula of population divided by area, the density of the population was determined.
3. The location quotient approach is used to analyse the geographical distribution of Taluk hospitals, 24x7 Primary Health Care Centres, Family Health Care Centres, and Community Health Centres. LQ results more than 1 indicate high spatial concentration, 1 indicate equal spatial concentration, and less than 1 indicate low spatial concentration of healthcare facilities.

4. The information displayed the authorised, operational, and necessary positions in the health workforce.

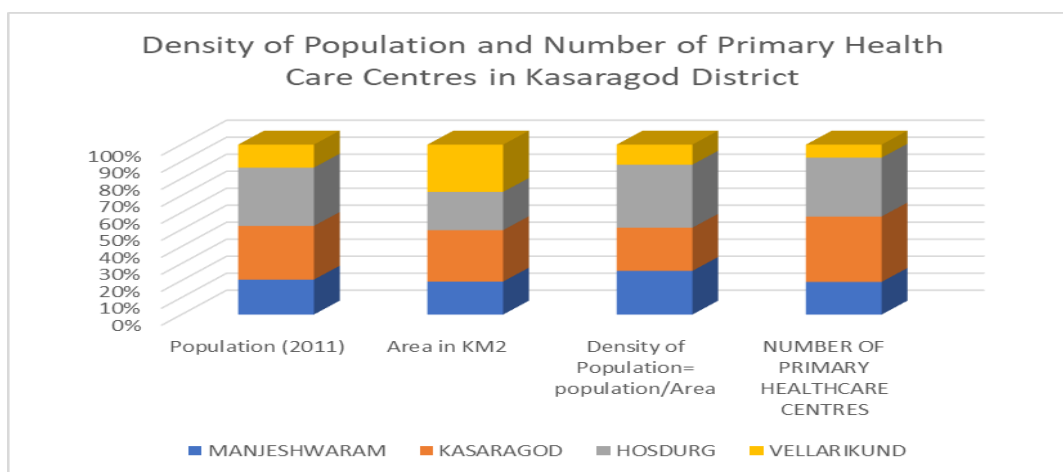
#### 5. RESULT AND DISCUSSION

This study primarily carried out the following significant works. Density of Population, Population and PHC Ratio, Total Number of Public Healthcare Facilities in Each Taluk, Location quotient of Public Healthcare Facilities in each taluk, Taluk wise Administration and its Population Distribution of Equal Count (Quantile), Logarithmic Method, and Required Posts of Health Workforce were all examined in this study.

Table 1: Density of Population and Population PHC Ratio in each Taluk

sl.no	TALUKS	Population (2011)	Area in KM2	Number of Villages	Density of Population = population/Area	NUMBER OF PRIMARY HEALTHCARE CENTRES	POPULATION/PHC RATIO (1:30000)	PHC required
1.	MANJESHWAR AM	268,642	382	48	703	5	53728	2
2.	KASARAGOD	413,094	594	34	695	10	41309	2
3.	HOSDURG	448,484	442	31	1014	9	49831	4
4.	VELLARIKUND	177,157	547	15	323	2	88578	2

[SOURCE: calculation conducted by the author]



[SOURCE: CREATED BY AUTHOR]

Table 1 lists the four taluks of the Kasaragod district, which are Manjeshwaram, Kasaragod, Hosdurg, and Vellarikund. It also lists the number of villages in each taluk, the population density in each taluk, the number of primary health care centres in each taluk, the population and PHC ratio

based on 1:30000, and the required PHC in each taluk based on population PHC ratio.

#### 5.1. Density of Taluk Population

##### 1. Hosdurg Taluk:

In these four taluks, Hosdurg taluk had the second highest population according to the

2011 census. With a 442 sq km area, it has 448484 inhabitants. The following formula is used to calculate population density:

Population Density = Total Population/Area per sq km.

Density of Hosdurg Taluk =  $448484/442=1014$  persons per square km.

In Hosdurg Taluk, there are 1014 people living in each square kilometre. The largest population density is seen in this hosdurg taluk, where people are highly concentrated.

#### 2. Manjeshwar Taluk:

Manjeshwaram Taluk, which has an area of 382 square kilometres and is the taluk with the least area, comes in second in terms of population density. Majeshwaram has a lower land area than the other Taluks but a higher population density of roughly 703 people per square km.

#### 3. Kasaragod Taluk:

The biggest taluk in Kasaragod district is Kasaragod taluk, in terms of area. It covers 594 sq km of space. The population of Kasaragod Taluk is 413094. The population density is 695 people per square kilometre.

#### 4. Vellarikundu Taluk:

The Vellarikundu taluk has an area of 547 sq km and a population of 177157, making its population density per sq km equal to 323 people per sq km. The upland region is where Vellarikundu Taluk is situated. The least inhabited area is there.

The ratio is calculated by dividing the entire population of each taluk by the total number of PHC. This ratio is based on the 1:30000 rule, which correlates to one PHC for every 30000 people. In

#### 1. Manjeshwar Taluk:

According to the 2011 census, Manjeshwaram has a total population of 268,642. There are 5 PHCs in the taluk, with a ratio of around 53728. It indicates that the population is in excess of the ratio of 1:30000 by 53728. Thus, there are two more PHC needed here.

#### 2. Kasaragod Taluk:

Kasaragod taluk has 413,094 inhabitants overall by the 2011 census. The taluk has ten PHCs, and their ratio is around 41309, as a result, the population is in excess by 41309 compared to the ratio of 1:30000. So, here inhabitants need an additional 2 PHC.

#### 3. Hosdurg Taluk:

Total population of Hosdurg Taluk is 448,484. The taluk has 10 PHCs, and since their ratio is more than 1:30000 (about 49831), the population is higher. As a result, the local population needs 2 more PHC.

#### 4. Vellarikundu Taluk:

Vellarikundu Taluk has a total population of 177,157. Due to the presence of two PHCs, the population of the taluk of Vellarikundu is more than it ought to be based on the ratio of 1:30000 by 88578. Therefore, the population requires three more PHC.

## 5.2. Population and PHC Ratio

sl.no.	Name of Healthcare Centres	Number of Healthcare centres
1.	Health Sub- Centers	247
2.	Primary Health Care Centers	26
3.	Family Health Care Centers	6
4.	24*7 Health Care Centers	6
5.	Community Health Care Centers	6
6.	Taluk hospitals	1
7.	Taluk Head Quarters Hospitals	4
8.	General Hospital	1
9.	District Hospital	1
	Total =	298

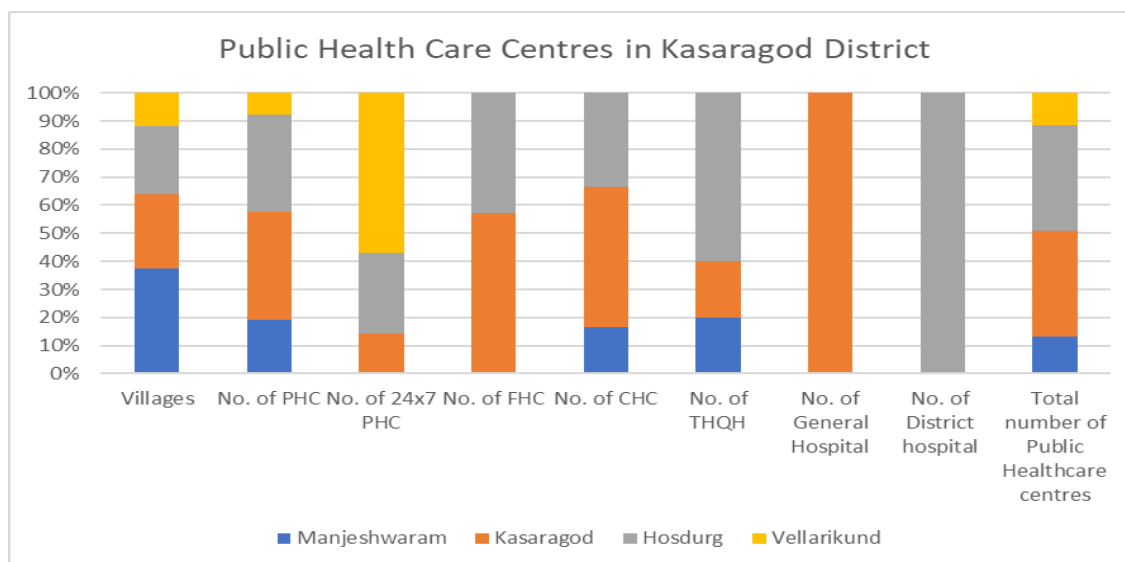
(Source: District hospital office)



**Table 2: NUMBER OF PUBLIC HEALTH CARE CENTRES IN KASARAGOD DISTRICT**

Sl no	Taluk	Population (2011)	Area in KM <sup>2</sup>	Villages	No. of PHC	No. of 24x7 PHC	No. of FHC	No. of CHC	No. of THQH	No. of General Hospital	No. of District hospital	Total number of Public Healthcare centres
1.	Manjeshwaram	268,642	382	48	5	0	0	1	1	0	0	7
2.	Kasaragod	413,094	594	34	10	1	4	3	1	1	0	20
3.	Hosdurg	448,484	442	31	9	2	3	2	3	0	1	20
4.	Vellarikund	177,157	547	15	2	4	0	0	0	0	0	6

[SOURCE: Field survey conducted by the author]



[SOURCE: CREATED BY AUTHOR]

Manjeshwaram Taluk has seven public healthcare systems in total. About 20 public health care systems are located in the Kasaragod Taluk. Only six public healthcare facilities are located in Vellarikundu Taluk, compared to 20 in Hosdurg Taluk. The two main hospitals, District Hospital and General Hospital, are located in Hosdurg Taluk and Kasaragod Taluk, respectively. With the exception of Vellarikund Taluk, taluk hospitals are considerably larger than community health care facilities and are located in Kasaragod, Hosdurg, and Majeshwar Taluks. Three taluk hospitals are in Hosdurg. There are two PHCs and four 24-hour PHCs in the Vellarikund taluk. This study demonstrates how few public health care facilities there are in the Vellarikundu taluk. This study reveals that the Vellarikundu taluk, which has 177,157 residents, has a very low number of public health care facilities, such as two PHCs and four 24-hour PHCs. There are five PHCs,

one CHC, and one taluk hospital serving the 268,642 population of Manjeshwar taluk. Since there are many Edosulfan victims spread over the entire district, the government should be required to increase the number of public healthcare facilities in this district based on taluk wise health facilities; otherwise, each Taluk will suffer from a shortage of these services.

### 5.3. Location quotient

In essence, location quotient (LQ) measures how concentrated a certain industry, cluster, vocation, or demographic group is in a region when compared to the entire country. It can show what distinguishes one area as "unique" in relation to the rest of the country. Determining local or regional specialty is one of the location quotient's basic applications. Here, LQ is incredibly good at immediately identifying those sectors or specialties that stand out due to their higher-than-average

employment per capita. This is what distinguishes the economy.

**Table: 3. LOCATION QUOTIENT OF PUBLIC HEALTH CARE CENTRES IN KASARAGOD**

Sl. No	Taluk	L. Q. OF PHC	DESCRIPTION of L.Q. of PHC	L.Q. OF 24X7P HC	Description of L.Q. of 24x7PHC	L. Q. OF FHC	Description of L.Q. of FHC	L. Q. OF CHC	Description of L.Q. of CHC	L.Q. OF THQH	Description of L.Q. of THQH
1.	Manjeshwar	0.94	LOW SPATIAL CONCENTRATION	0	No Spatial Concentration	0	No Spatial Concentration	0.8	LOW SPATIAL CONCENTRATION	0.97	LOW SPATIAL CONCENTRATION
2.	Kasaragod	1.22	High Spatial Concentration	0.45	Very Low Spatial Concentration	1.8	High Spatial Concentration	1.58	High Spatial Concentration	0.63	LOW SPATIAL CONCENTRATION
3.	Hosdurg	1	Equal Spatial Concentration	0.83	LOW SPATIAL CONCENTRATION	1.2	High Spatial Concentration	0.97	LOW SPATIAL CONCENTRATION	1.74	High Spatial Concentration
4.	Vellarikund	0.57	Very Low Spatial Concentration	0.42	Very Low Spatial Concentration	0	No Spatial Concentration	0	No Spatial Concentration	0	No Spatial Concentration

[SOURCE: Field survey conducted by the author]

In this case, the location quotient is calculated using the formula total PHC in a taluk/total population in the taluk divided by

total PHC in Kasaragod district/total population in the district.

The formula for Location quotient:

$$\text{Location Quotient} = \frac{\text{Total PHC in a Taluk/ Total population in the Taluk}}{\text{Total PHC in Kasaragod District/Total population in the district}}$$

Value for the location quotient One indicates equal spatial concentration, more than one indicates high spatial concentration, and less than one demonstrates low spatial concentration of healthcare facilities.

Table 3. illustrates that there are no ‘24-hour PHCs or FHCs’ in the Manjeshwar taluk, which is indicated by the location quotient having a value of 0.

In Vellarikund Taluk, there are no ‘FHC, CHC, or Taluk Hospitals’, hence the location quotient value is displayed as 0.

Based on data from ‘PHC, CHC, THQH’ in Manjeshwar taluk and PHC,24-hour PHC in Vellarikund, less than one value denotes low spatial concentration.

The existence of ‘FHC, THQH’ in Hosdurg Taluk and ‘PHC, CHC, and FHC’ in Kasaragod Taluk at significant regional

concentrations is indicated by a location quotient value greater than one.

The presence of PHC in Hosdurg taluk is indicated by the location quotient value of 1, which shows an equal spatial concentration of healthcare facilities.

In manajeshwar and vellarikundu taluk have low spatial concentration of public healthcare centres. Therefore, the government needs to start implementing additional public healthcare facilities in these locations.

#### 5.4. Taluk wise Administration and its Population Distribution of Equal Count (Quantile)

The taluk-wise subdivision categorization is done using QGIS software. Based on the population distribution, this division was made. The district's most populated taluk in Kasaragod. Manjeshwar Taluk is the third

most populous of the district's four taluks. Hosdurg Taluk is ranked second, and Vellarikund Taluk is the least populated.

#### 5.4.1. Manjeshwaram taluk wise Population distribution by Equal Count (Quantile)

Kerala's Manjeshwaram Taluk, which borders Karnataka State, is the state's most northern Taluk. It is situated in Kasaragod district, which was established in 2013 from Kasaragod taluk, in Kerala. The 48 revenue villages comprise the Manjeshwaram taluk. Karnataka state has a border with the Manjeshwaram Taluk, this taluk is close to the city of Mangalore in Karnataka. Many people depend on the city of Mangalore for their medical care. There are numerous multispecialty medical facilities in the city of Mangalore. Within this taluk is the Endosulfan-affected village of Enmakaje.

#### The 48 revenue villages belong to Manjeshwaram taluk they are:

Kunjathur, Hosabettu, Udyavar (Manjeshwaram CT), Hosangadi, Badaje are among the *Manjeshwaram Panchayat's* constituents.

Meenja, Kadambar, Koliyoor, Kaliyoor, Talakala, Kuloor, Majibail, and Moodambail make up the *Meenja Panchayat*.

Vorkady, Pavor, Kodalamogaru, and Pathur comprise *Vorkady Panchayat*.

*Palike Panchayat*: Palike, Chippar, Bayar, Kayyar, with Kudalmarkala.

Kattukukke, Padre, Shen, among *Enmakaje Panchayat*.

*Panchayat Puthige*: Edanad, Badoor, Kannur, Puthige, Angadimogaru, Mugu. Kumbala, Ichilampady, Mogral, Bombrana, Arikady, Kidoor, Ujarulvar are in *Kumbala Panchayat*.

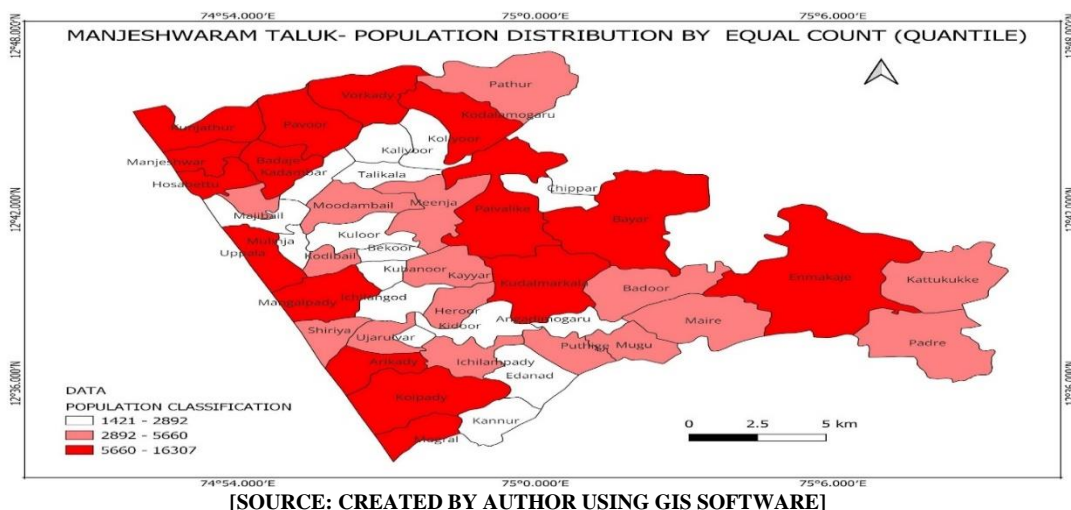
*Mangalady Panchayat*: Kubanoor, Bekoor, Heroor, Shiriya, Uppala, Mannamkuzhi, Ichilangod, Mangalady, and Pathwadi.

#### Population Distribution:

Kunjathur, Manjeshwaram, Pavor, Vorkady, Uppala, Mangalady, Paivalike, Hosangadi, Badaje, Kodalamogaru, Bayar, Kudalmarkala, Enmakaje, Arikady, Koipady, and Mogral are the villages in Manjeshwaram Taluk with the highest population distribution. There are approximately 5660 to 16307 people living there.

Majibail, Kadambar, Thalikal, Kaliyoor, Koliyoor, Mulincha, Kuloor, Bekoor, Kubanoor, Ichilangod, Kidoor, Angadimogaru, Kannur, Edanad, and Chippar have the least number of inhabitants. The lowest population ranges from 1421 to 2892. In Manjeshwaram Taluk, the population is distributed in this analysis between (1). 1421-2892, (2). 2892-5660, (3). 5660- 16307.

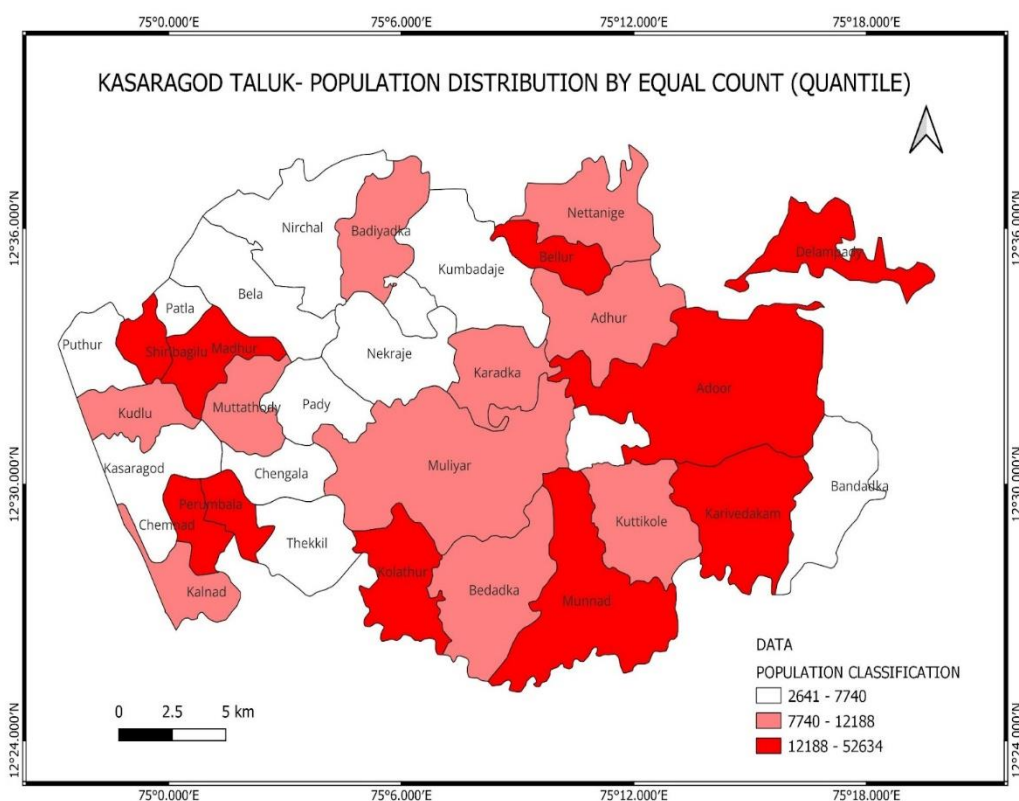
One of the places with a high HIV infection rate is Manjeshwar Taluk. There are no specific medical services or specialists for HIV patients in this region. Dharmathadka, Manjeshwar, Bandiyod, Nileschwaram, Vellarikundu, Kasaragod town, and Padannakkad are among the localities in Kasaragod district that are HIV-affected.



### 5.4.2. Kasaragod Taluk wise Population distribution by Equal Count (Quantile)

Kasaragod Taluk is made up of 34 villages. The following names are included in this list: Adkathbail, Adoor, Adhur, Badiadka, Bandadka, Bedadka, Bela, Bellur, Chengala, Delampady, Kalnad Karadka, Kasaragod, Kolathur, Kudlu, Muliyar, Munnad, Madhur, Kumbadaje, Kuttikole, Muttathody, Nettanige, Pady, Patla, Neerchal, Nekraje, Perumbala, Puthoor, Shiribagilu, Thalagara, chemnad, karivedakam, Thekkil, Ubrangala.

Kasaragod: The Kasaragod taluk with densely populated areas is Mogral, Mogralputhur, Kudlu, Kasaragod, Muttathody, Kalanad, Chemnad, Chengala, Thekkil, Muliyar, Bedadka, Kodom. More than 2500 people live in the villages that make up Kasaragod Taluk. This area is thickly populated with up to 50000 people. This computation, the population of Kasaragod Taluk is distributed between (1). 2641-7740, (2). 7740-12188, (3). 12188- 52634



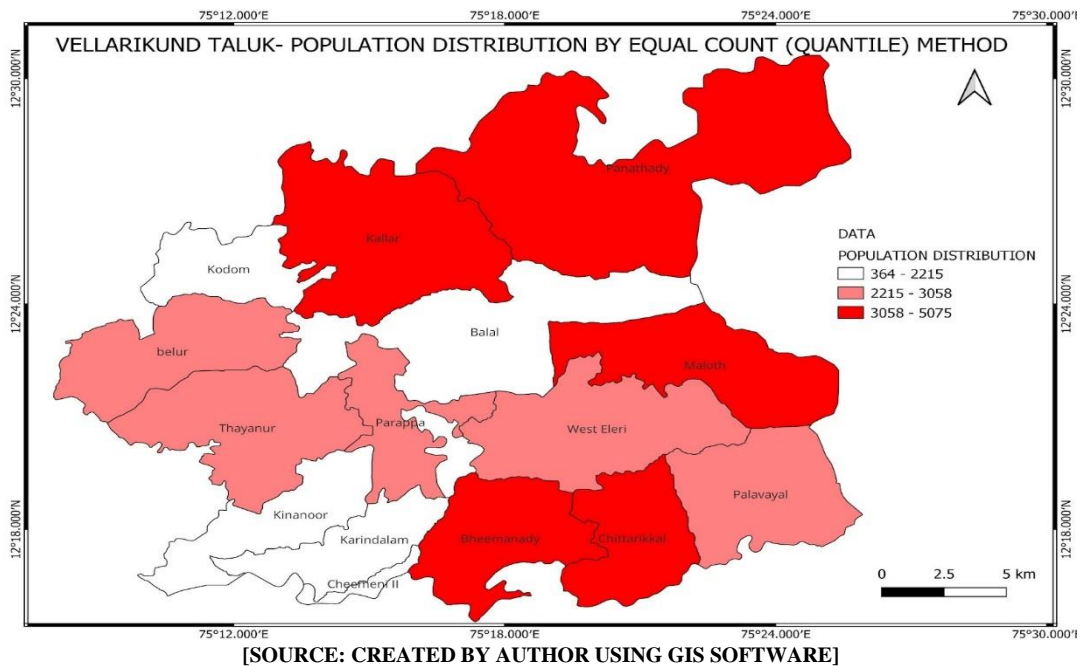
[SOURCE: CREATED BY AUTHOR USING GIS SOFTWARE]

### 5.4.3. Vellarikund Taluk

The Vellarikundu Taluk is in charge of 15 populated villages. Balal, Bheemanady, Belur, Cheemeni-II, Chittarikkal, Karindalam, Kinanoor, Kodom, Maloth, Palavayal, Parappa, Thayannur, West Eleri, Kallar, and Panathady are some of them. The villages with more populous inhabitants in Vellarikund taluk range Level 3058–5075

are bheemanady, kallar, panathady, chittarikkal, maloth. The lowest number of populations resides in the villages of Kodom, Balal, Kinanoor, Karindhalam, Cheemeni11 in Vellarikund taluk. (364-2215). This estimate divides the population of the Vellarikundu Taluk into (1). 364-2215, (2). 2215-3058, (3). Level 3058–5075.

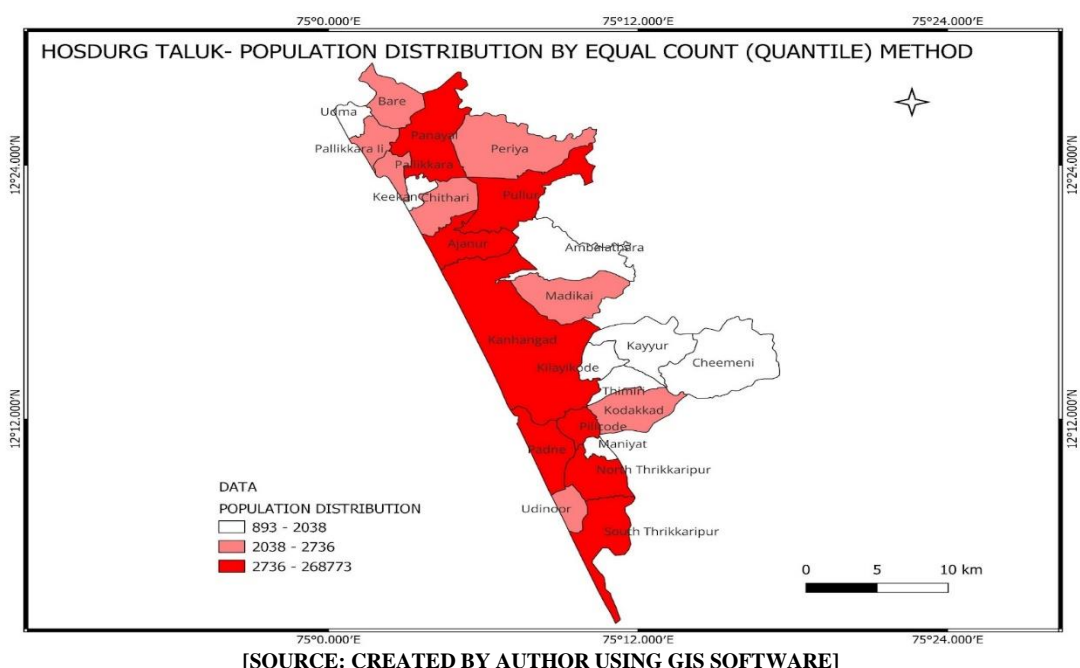




**5.4.4. Hosdurg Taluk wise Population distribution by Equal Count (Quantile)**

Hosdurg taluk has 31 revenue villages, they are Ajanur, Ambalathara, Balla, Bare, Cheemeni, Cheruvathur, Chithari, Hosdurg, Kanhangad, Kayyur, Keekan, Kilayikode, Kodakkad, Madikai, Maniyat, Nileshwaram, North Trikkarippur, Padanna, Pallikkara, Pallikkara-II, Panayal, Periya, Perole, Pilicode, Pudukai, Pullur, South Trikkarippur, Thimiri, Thuruthi, Uduma, Udinoor and Valiyaparamba.

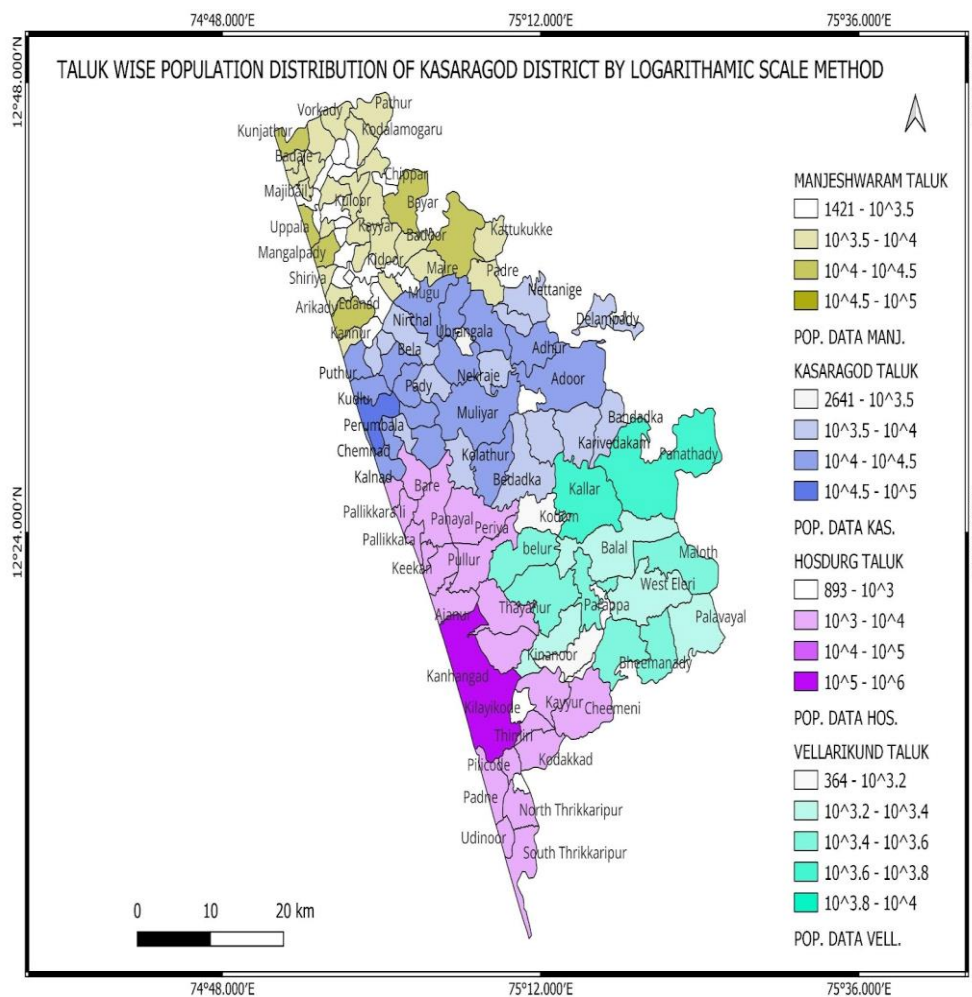
The highest population distribution is located in those villages of Pullur, Ajanur, Kanhangad, Padne, North Thrikaripur, South Thrikaripur, Panayal in Hosdurg Taluk. The lowest number of population resides in the villages of udma, Kaiyur, Cheemeni 1, in Hosdurg taluk(893-2038), the range up to 25000 people. The Hosdurg Taluk's population is divided according to this estimation (1). 893-2038, (2). 2038-2736, (3). 2736-268773.





Hosdurg and Kasaragod taluks have substantial populations. These two taluks have high population densities. Therefore, the majority of the private and public health care facilities are found here. The majority of the Kasaragod taluk's land area is made up of

the three land masses of low land, midland, and highland. although Hosdurg's largest landmass is in the lowland region. Low- and high-land areas are where people prefer to dwell.



The distribution of people is depicted on this map using a logarithmic scale. This categorization technique is used to display continuous data that is not regularly distributed. Dark colours indicate dense population of villages, while light colours indicate sparse population.

The Kasaragod district has three different sorts of landmasses:

- (1). Coastal area
- (2). Midland
- (3). High terrain

West of Kasaragod lies the Arabian Sea, east is the Western Ghats, south is Kannur district, and north is Karnataka state. Because

of how plain this region is, people live in great numbers around the Coastal area. Although Midland is also where most people choose to live, there are few people in the high land area.

The population of Taluk Vellarikundu is lower than that of other Taluks. It is situated in a highland region. The other three taluks are Kasaragod, Manjeshwaram, and Hosdurg, which are situated in the midland and coastal plain regions, respectively.

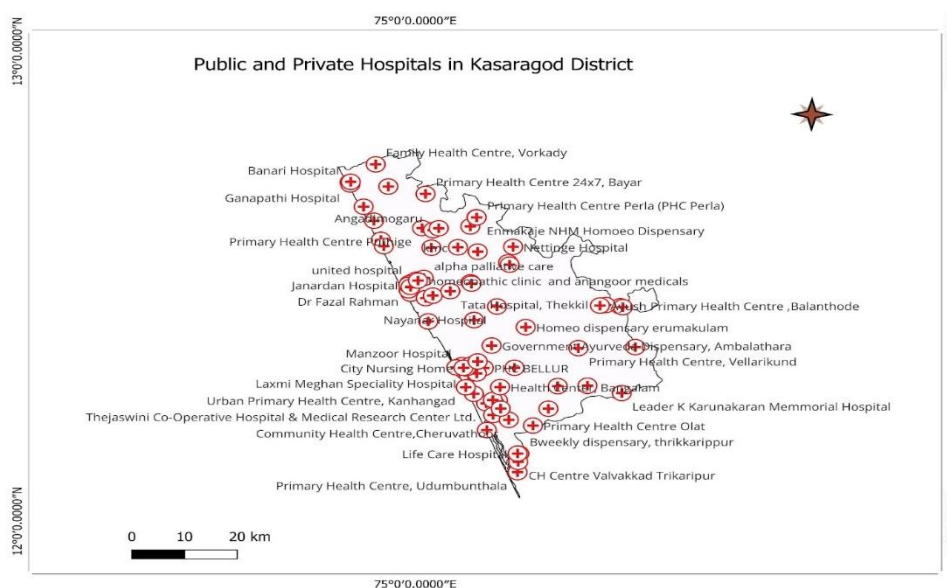
### MAJOR PRIVATE HOSPITALS IN KASARAGOD DISTRICT:

SL.NO.	NAME OF PRIVATE HOSPITALS	LOCATION AT	LATITUDE	LONGITUDE
1.	Aramana Hospital	KASARAGOD	12.501928	74.991732
2.	Carewell Hospital & Research Centre Pvt Ltd	NULLIPADY	12.506849	74.990265
3.	Deepa Nursing Home	KANHANGAD	12.325361	75.088997
4.	Kamath & Kamath Medical Centre	KASARAGOD	12.506200	74.991341
5.	Arimala Hospital	KANHANGAD	12.325343	75.084991
6.	Chaithra Medical Centre	KANHANGAD	12.516966	75.011871
7.	K A H M Hospital	CHERUVATHUR	12.234296	75.153038
8.	Kasaragod Institute of Medical Sciences	KASARAGOD	12.499700	74.987000
9.	Krishna Hospital	KASARAGOD	12.517079	75.013145
10.	Malik Deenar Charitable Hospital Kasargod	KASARAGOD	12.484674	74.992218
11.	Manzoor Hospital	KANHANGAD	12.33249	75.08121
12.	P.N. Panicker Souhrua Ayurveda Medical College	KANHANGAD	12.30845	75.08604
13.	Sanjeevani Institute of Medical Sciences	KANHANGAD	12.34047	75.10870
14.	Laxmi Meghan Speciality Hospital	KANHANGAD	12.32193	75.08904
15.	Mallya City Hospital	KASARAGOD	12.50777	74.98937
16.	Mothers Hospital	KANHANGAD	12.30620	75.09465
17.	Padma Poly Clinic & Hospital	KANHANGAD	12.32871	75.08277
18.	MAMS Comtrust Eye Care Hospital	KANHANGAD	12.34026	75.10861
19.	Sunrise Hospital	KANHANGAD	12.33518	75.09449
20.	Thejaswini Co-operative Hospital	NILESHWARAM	12.25975	75.13425
21.	Shashirekha Multi Speciality hospital	KANHANGAD	12.33317	75.095431
22.	Unity Care and Health Services Pvt Ltd.	CHERUVATHUR	12.21376	75.15746
23.	Dr Prajwals Laser and Cosmetic Surgery centre	KANHANGAD	12.33304	75.09544
24.	The Kasaragod District Co-operative hospital	Kumbla	12.59311	74.94647
25.	KNH Hospital	Uppala	12.66997	74.90986

[Source: Field survey by Author]

In the district, there are 25 private hospitals. The majority of these are found in the taluks of Kasaragod and Kanhangad. Since private

hospitals have financial incentives to profit from medical services, residents pay much more at private hospitals than at public ones.

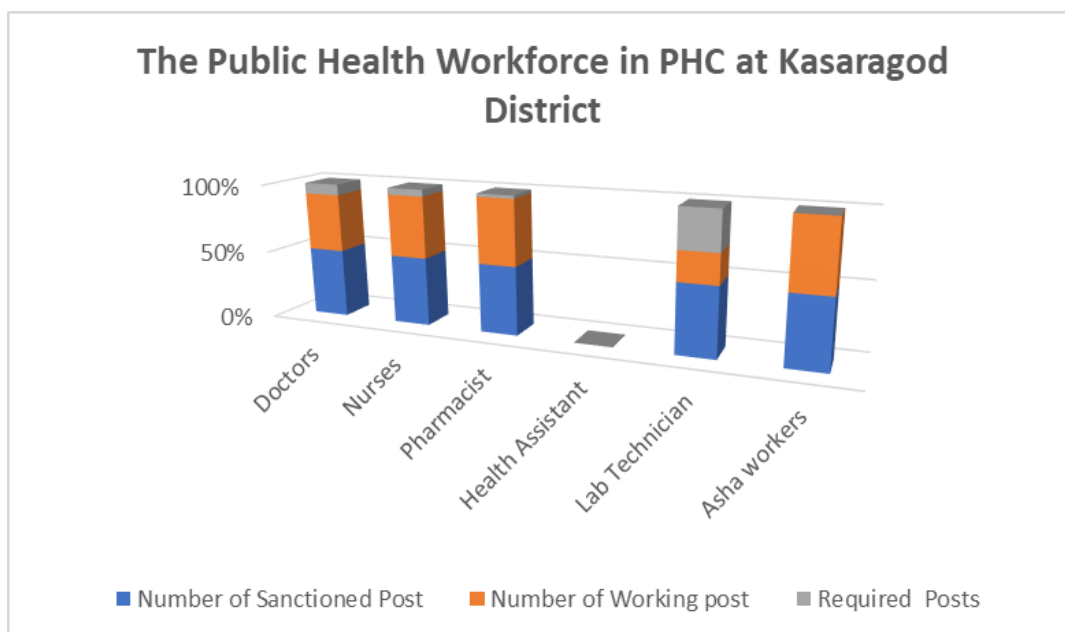


[SOURCE: Created by the author using the help of GIS software]

### The Public Health Workforce in Kasaragod District:

sl.no	Name of Workforce in PHC	Number of Sanctioned Post	Number of Working posts	Required Posts
1	Doctors	38	32	6
2	Nurses	31	28	3
3	Pharmacist	22	21	1
4	Health Assistant	0	0	0
5	Lab Technician	7	3	4
6	Asha workers	627	627	0

[Source: District Health Office Kanhangad]

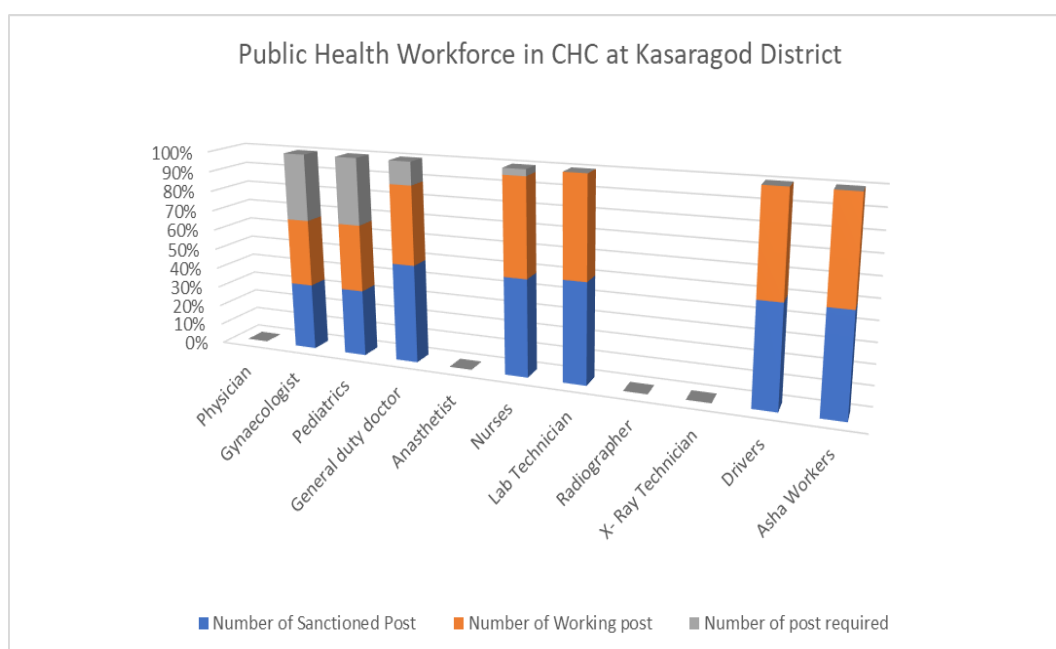


[SOURCE: CREATED BY AUTHOR]

There are 32 doctor's functional positions in primary health care centres in contrast to the 38 sanctioned doctor posts. In PHC's, there are just six doctors, which is not enough.

sl.no	Name of Workforce in CHC	Number of Sanctioned Post	Number of Working posts	Number of posts required
1	Physician	0	0	0
2	Gynaecologist	1	1	1
3	Paediatrics	1	1	1
4	General duty doctor	30	24	7
5	Anaesthetist	0	0	0
6	Nurses	15	15	1
7	Lab Technician	8	8	0
8	Radiographer	0	0	0
9	X- Ray Technician	0	0	0
10	Drivers	3	3	0
11	Asha Workers	145	145	0

[Source: District Health Office Kanhangad]

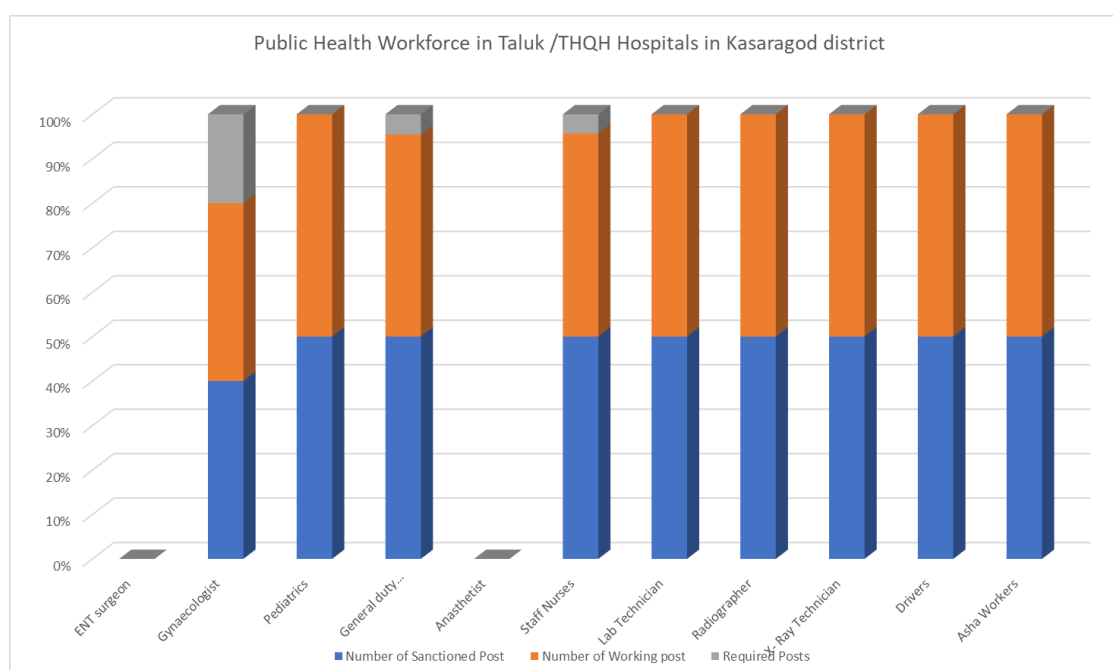


[SOURCE: CREATED BY AUTHOR]

There are no positions available for physicians, anaesthetists, radiographers, or X-ray technicians at the CHC. Actually, only 24 of the 30 general duty doctor positions have been filled by the CHC.

sl.no	Name of Workforce in Taluk Hospitals/THQH	Number of Sanctioned Post	Number of Working post	Required Posts
1	ENT surgeon	0	0	1
2	Gynaecologist	2	2	1
3	Paediatrics	3	3	0
4	General duty doctors	11	10	1
5	Anaesthetist	0	0	0
6	Staff Nurses	70	64	6
7	Lab Technician	14	14	0
8	Radiographer	1	1	0
9	X- Ray Technician	1	1	0
10	Drivers	4	4	0
11	Asha Workers	45	45	0

[Source: District Health Office Kanhangad]

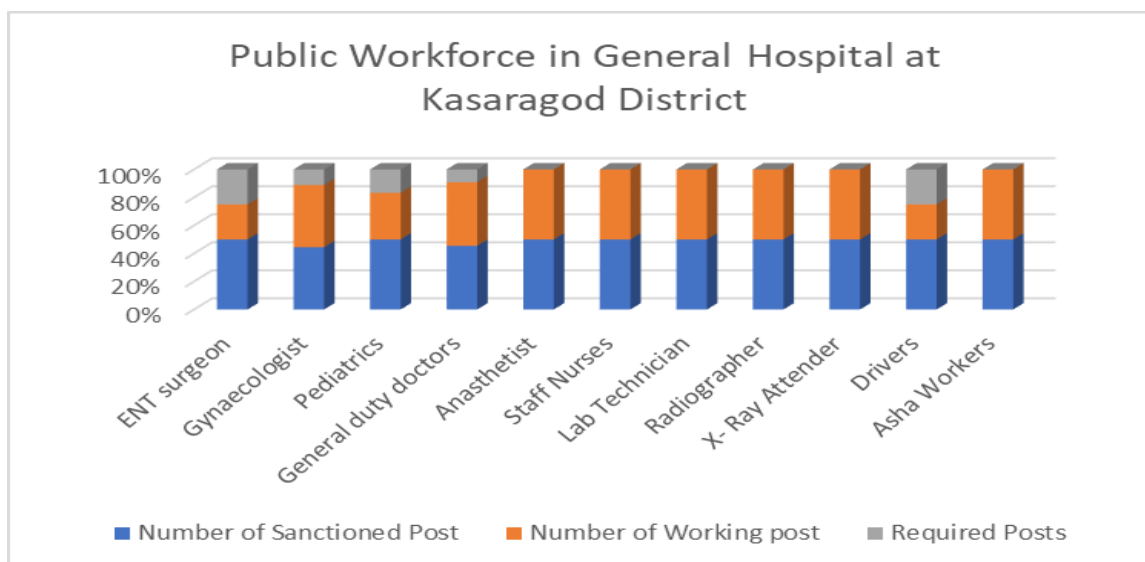


[SOURCE: CREATED BY AUTHOR]

The number of sanctioned doctor positions at THQH is 11, whereas the actual number of doctor positions is 10. 64 nurses are now employed here out of 70 total positions for nurses. There are no posts for anaesthetists or ENT doctors here.

sl.no	Name of Workforce in General Hospital Kasaragod	Number of Sanctioned Post	Number of Working post	Required Posts
1	ENT surgeon	2	1	1
2	Gynaecologist	4	4	1
3	Paediatrics	3	2	1
4	General duty doctors	5	5	1
5	Anaesthetist	2	2	0
6	Staff Nurses	77	77	0
7	Lab Technician	4	4	0
8	Radiographer	2	2	0
9	X- Ray Attender	2	2	0
10	Drivers	2	1	1
11	Asha Workers	38	38	0

[Source: District Health Office Kanhangad]

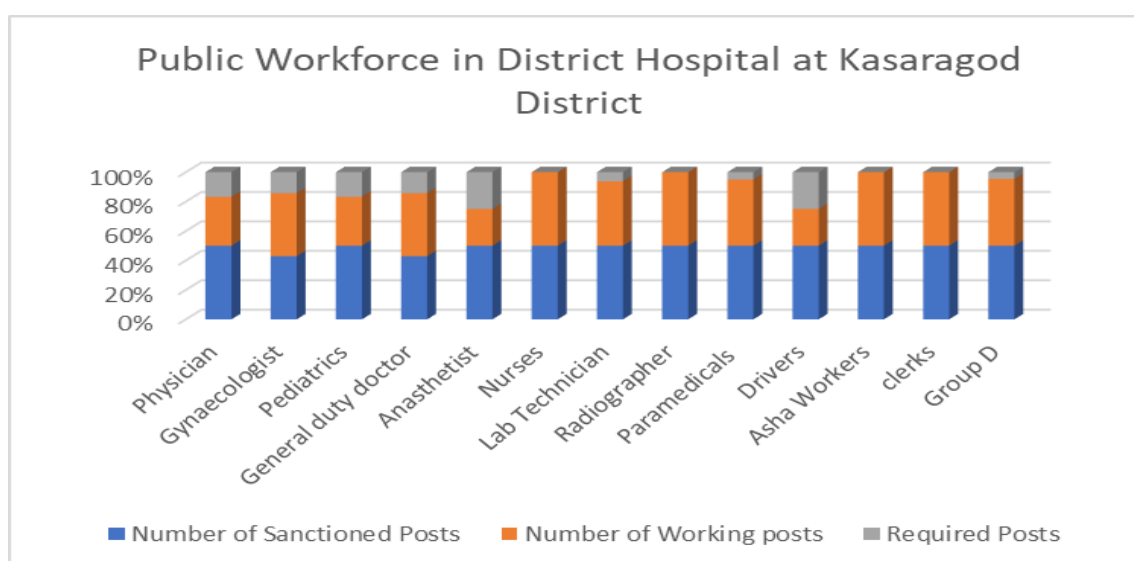


[SOURCE: CREATED BY AUTHOR]

The number of ENT specialists registered to work at Kasaragod General Hospital is two, however only one is actually employed there. Paediatrics has three authorised roles, although there are only two working positions. permitted two drivers, but only one.

sl.no	Name of Workforce in District Hospital	Number of Sanctioned Posts	Number of Working posts	Required Posts
1	Physician	3	2	1
2	Gynaecologist	3	3	1
3	Paediatrics	3	2	1
4	General duty doctor	3	3	1
5	Anaesthetist	2	1	1
6	Nurses	68	68	0
7	Lab Technician	8	7	1
8	Radiographer	3	3	0
9	Paramedical	231	208	23
10	Drivers	4	2	2
11	Asha Workers	11	11	0
12	clerks	6	6	0
13	Group D	44	40	4

[Source: District Health Office Kanhangad]



[SOURCE: CREATED BY AUTHOR]

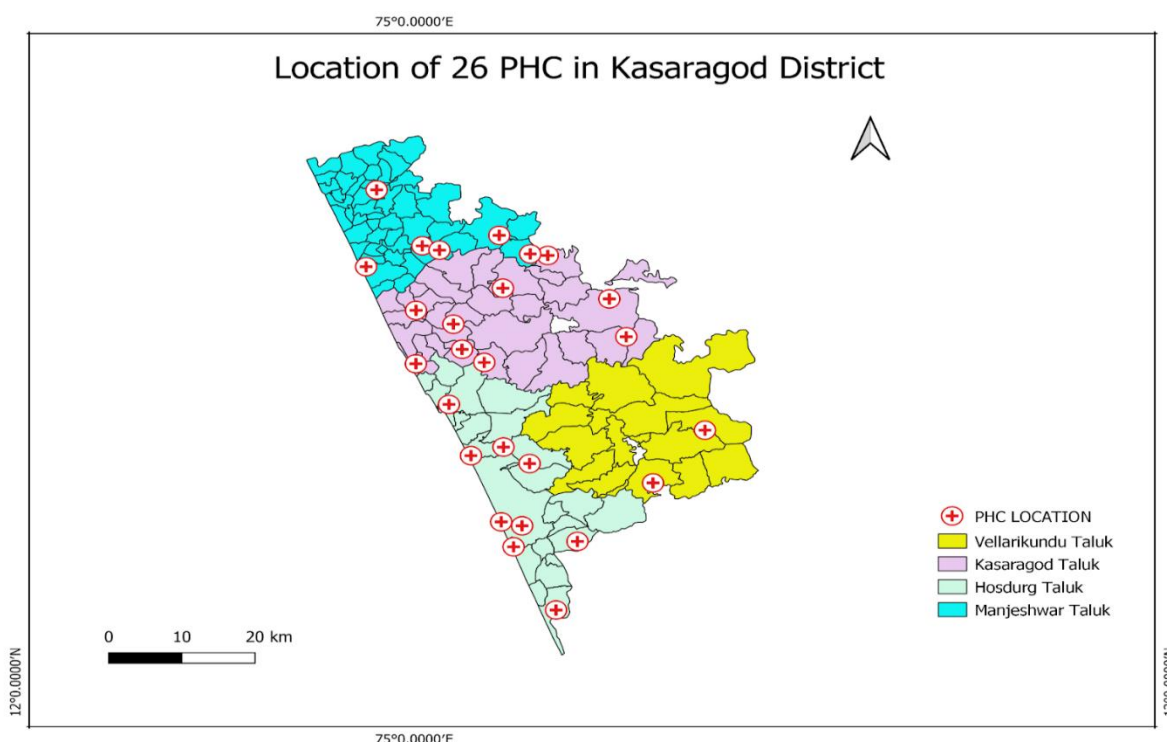


The District Hospital in Kasaragod has 208 active paramedical positions despite having 231 sanctioned positions. There are three paediatricians on staff here, however there are only two positions available.

### MAJOR GOVERNMENT HOSPITALS AND ITS LOCATION IN KASARAGOD

sl.no.	Name of PHC	Taluk	Location: Latitude	Longitude
1	PHC MOUCODE	VELLARIKUND	12.28859	75.29986
2	PHC KONNAKKAD	VELLARIKUND	12.36505	75.36509
3	PHC MEENJA	MANJESHWARAM	12.71309	74.95285
4	PHC PUTHIGE	MANJESHWARAM	12.63209	75.01020
5	PHC ANGADIMOGARU	MANJESHWARAM	12.62579	75.03174
6	PHC PERLA	MANJESHWARAM	12.64724	75.10679
7	PHC BELLUR	MANJESHWARAM	12.61811	75.16773
8	PHC KARICHERI	KASARAGOD	12.46320	75.08792
9	PHC BANDADKA	KASARAGOD	12.50037	75.26627
10	PHC CHATTANCHAL	KASARAGOD	12.48223	75.06010
11	PHC KALANAD	KASARAGOD	12.46126	75.00210
12	PHC CHENGALA	KASARAGOD	12.51861	75.04914
13	PHC ADOOR	KASARAGOD	12.55524	75.24501
14	PHC ARIKADY	KASARAGOD	12.60184	74.93960
15	PHC MADHUR	KASARAGOD	12.53860	75.00222
16	PHC KUMBADAJE	KASARAGOD	12.57076	75.11133
17	PHC VANINAGAR	KASARAGOD	12.62036	75.14571
18	PHC THAIKADAPURAM	HOSDURG	12.23227	75.10922
19	PHC THURUTHI	HOSDURG	12.22653	75.13546
20	PHC OLAT	HOSDURG	12.20392	75.20499
21	PHC MAVILAKADAPURA	HOSDURG	12.19610	75.12481
22	PHC UDUMBUNTHALA	HOSDURG	12.10457	75.17811
23	PHC PALLIKKARE	HOSDURG	12.40240	75.04363
24	PHC AJANUR	HOSDURG	12.32813	75.07129
25	PHC ANADASRAM	HOSDURG	12.34059	75.11208
26	PHC MADIKAI	HOSDURG	12.31672	75.14490

The distribution of the 26 PHC's x and y coordinates might be displayed on a map using GIS software. It is obvious that the taluks of Manjeshwaram and Vellarikundu have less PHCs installed.



[SOURCE: Created by the author using the help of GIS software]

### **A glimpse of the outcome from this analysis:**

The population density can be used to calculate how many people permanently inhabited each square kilometre of distance. PHC ratio was determined using the rule of 1:30000 to determine how many PHC were required for the population. In other words, one PHC for 30.000 persons. This investigation pointed out that the healthcare system in Kasaragod district is insufficient in all four of the taluks. Each taluk's location quotient identifies which taluk has a low, average, or high concentration of the healthcare system. Using QGIS software, the administration and population distribution in each taluk by Equal Count or Quantile, and Logarithmic methods accurately identified each taluk's village-wise boundary and the number of people who live there. There are less health workers in the district, corresponding to the primary data on health workforce in public health care centres that was collected and calculated. Therefore, the government needs to assign enough health workers to the Kasaragod district.

### **6. CONCLUSION**

These surveys indicate that Kasaragod district inhabitants are more optimistic about the improvement of the healthcare system. Better, more efficient healthcare that satisfies population requirements will lead to the evolution of civilization. These are essential conditions for better living circumstances. The development of new institutions to train medical professionals, expanding the capacity of the current medical institutions to accept new patients, and upgrading district hospitals to medical college status are the three plans that the Indian government recently announced in 2019 to increase the supply of human resources in the health sector. The inhabitants of this district might develop if the Kerala Government executed the three programmes indicated above. This district's neighbouring state has several multi-specialty hospitals, so people receive treatment there instead, which is a major reason as the government is reluctant to

renovate the district's public hospitals. The Kasaragod district is a man-made disaster Endosulfan impacted area, hence there are many Endosulfan victims living here. Endosulfan was aerially sprayed for 20 years over Kasaragod's high cashew plantations covering thousands of hectares. Environmentalists and locals in this area started to worry that this spray was gradually poisoning people. The Kasaragod Medical College's construction started in 2013, however it hasn't been finished yet. Kasaragod people are demanding the construction of an AIIMS hospital. The healthcare problems of Kasaragod are incomprehensible.

The Kerala government plantation company has sprayed the toxic chemical pesticide endosulfan from the air. As a result, it is the Kerala government's vital duty to establish and flourish the medical facility for the inhabitants.

### **Declaration by Authors**

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**Source of Funding:** None

**Conflict of Interest:** The authors declare no conflict of interest.

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