Spatial Implications of Cancer

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Abstract:- Cancer is a generic word for a large group of diseases that can then invade adjacent parts of the organ and/or spread to other organs by the growth of abnormal cells beyond their usual limits. It is the world's second leading cause of death, estimated for 9.6 million deaths in 2018. Lung, prostate, colorectal, stomach and liver cancer are the most common types of cancer in men, while breast, colorectal, lung, cervix and thyroid cancer are the most common among women. Until now, the result is inevitable cancer sufferings and fatalities with the limitation of cancer control and cancer treatment centers in India, the only efficient way to address the increasing and humongous cancer burden is to focus on preventable cases of cancer where spatial factors play a critical part. Under this circumstance, the study starts the way to explore the relationship between Cancer Incidences and variables adding to it spatially and specifically, to improve long term public health. Reviewing these factors may contribute to the future design of preventive approaches for wider application.

Keywords:- Cancer, Non Genetic Factors, Spatial, Environment, Cancer Mapping.

I. INTRODUCTION

Cancer is the chief contributor of deaths worldwide and is estimated that 9.6 million death in 2018 is reported till today. Lung, prostate, colorectal, stomach and liver cancer are the most common types of cancer in men, while breast, colorectal, lung, cervix and thyroid cancer are the most common among women [1]. Many health systems in low- and middle-income countries are least ready to deal with this problem, and many cancer patients globally do not have access to appropriate, high-quality diagnosis or therapy.

The result at present is unavoidable miseries and deaths from cancer. With the limitation of Cancer control and facilities for Cancer treatment in India, the only effective way to tackle the rising and humongous cancer burden is focusing on preventable cancer cases were spatial factors play a pivotal role [2]. By evaluation of these factors may help in designing preventive strategies for a wider purpose in the future.

The high age-specific death rates in India is due to a combination of product of contrasting causal patterns, with infections and unique local patterns of tobacco, early- stage case finding services, poor access to screening and environmental factors [2].

A. Need of the Study

In the last several decades, researchers have began to consider the role of Spatial factors and environment in specific in Cancer Research. However, a reliable estimate for the extent of cancer owing to spatial factors are at present less accessible. Under this circumstance, the study starts the way to explore the relationship between Cancer Incidences and variables adding to it spatially specifically , to improve long term public health.

B. Reseach Question

- What are the spatial implications of the occurrence of Cancer?
- Can spatial planning address the environmental factors in a geographical area?

C. Objectives

Following objectives are formulated for this study:
- To identify and analyze associations between environmental factors and cancer incidences
- To explore the spatial implications on the occurrence of cancer in a specific geographic area
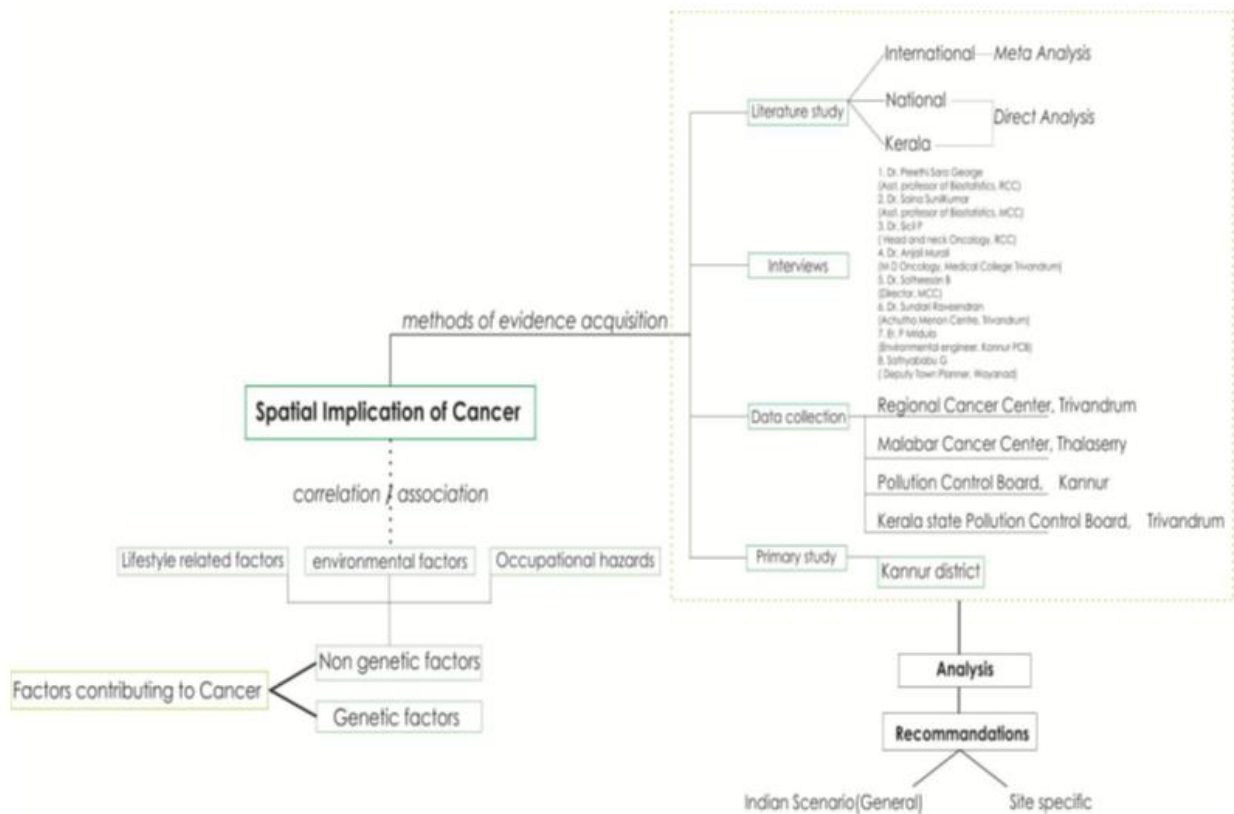
D. Methodology

Fig. 1.Methodology of the study

E. Limitations

Cancer is not a '*notifible*' disease in India and therefore notification of cancer cases are difficult. So the exact number of cancer cases or mortality is not available . People move in and out of a geographic area over time, which makes it difficult to identify the hazards or the specified number of patients effected to obtain the medical records to confirm the diagnosis of cancer. Cancer typically requires some time to develop and all relevant exposures in the past or in another geographical region from which cancer has been diagnosed may have happened.

Anticipating the difficulty in obtaining the required data due to reasons mentioned above, the study area is to be limited within Kerala.

II. FACTORS CAUSING CANCER

The broad classifications for Cancer include Genetic and Non genetic factors. A minority of cancers are due to inherited genetic mutations and most cancers are related to other Non Genetic causes.
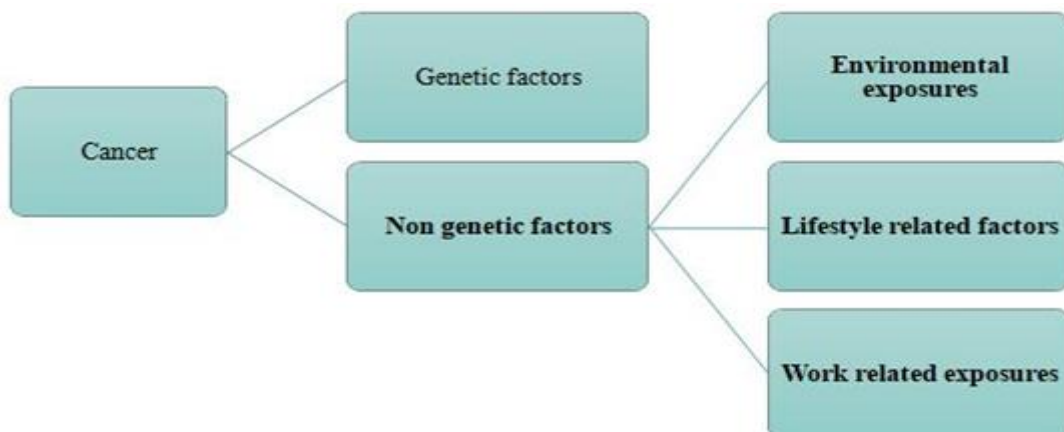

Fig. 2. Broad level clssification of Cancer

The genetic factors has numerous unsolved problems with regard to gene mutations, hereditary, age etc. which is

beyond the scope of the subject. Therefore, priority is given to Non genetic factors contributing to cancer.

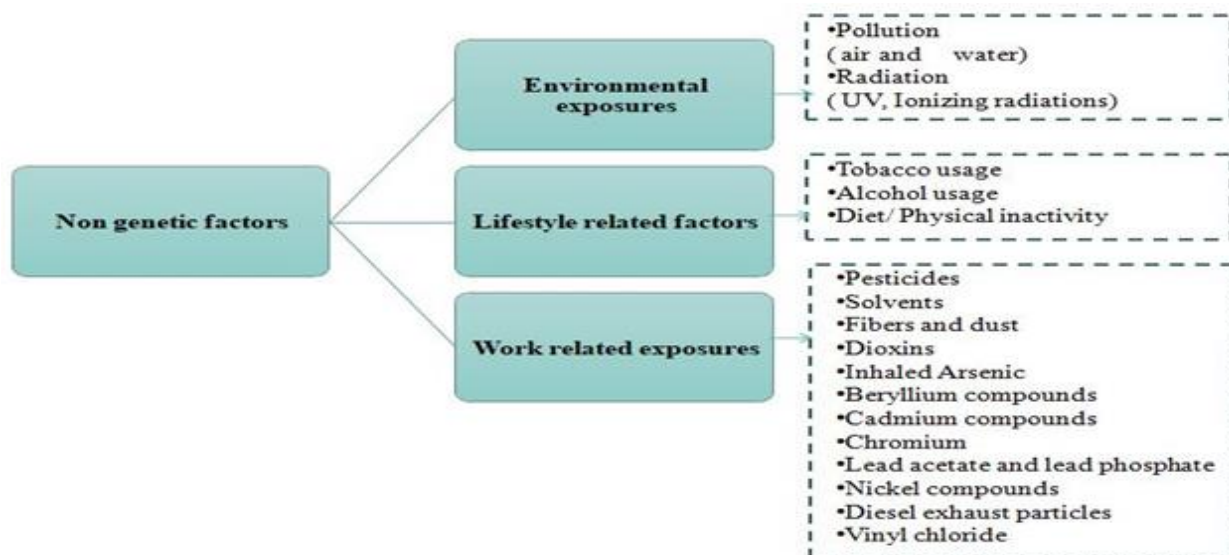*A. Non Genetic Factors contributing to Cancer*

Fig. 3.   *Classification of Non Genetic factors of Cancer*

B. Contribution of Environmental factors to Cancer Risk

It is estimated that as many as two-thirds of all cancer cases are linked to environmental causes [4]. There are substantial facts to support the association between the environmental factors and cancer relation. Still now, researchers continue to reveal and quantify the association, as well as identification of geographical variation in Cancer incidence. The most cited attributable risk of estimate comes from John Higginson, who declared that 80-90% of all cancers are due to environmental exposures [5].

The concept of environment is widely used, including all non-genetic factors such as diet, lifestyle, and infectious agents. The environment is associated in the cause of majority of human cancers in this broad sense. In a more specific sense, however, environmental factors include only the (natural or man-made) agents encountered by humans in their daily life, upon which they have no or limited personal control. The most important 'environmental' exposures, defined in this strict sense, include outdoor and indoor air pollution and soil and drinking water contamination [6].
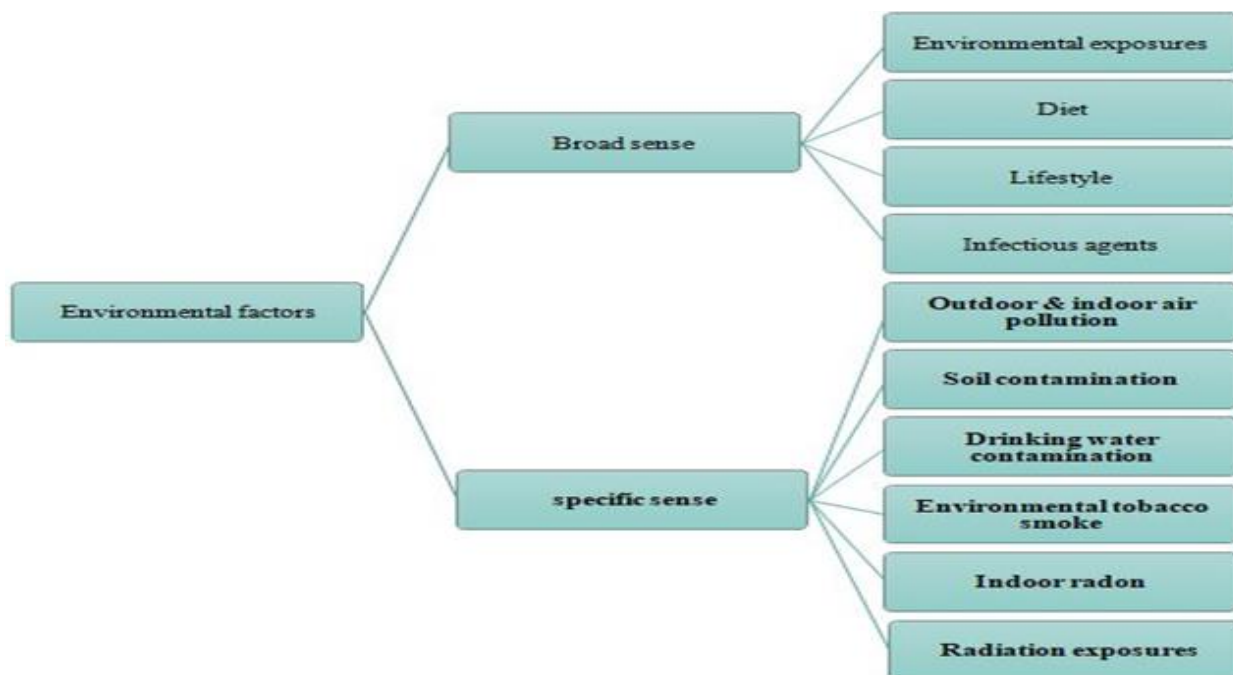

Fig. 4.Classification of Environmental factors of Cancer

III. NEW HEALTH PARADIGM; ANALYSIS OF ASSOCIATIONS BETWEEN ENVIRONMENTAL FACTORS(SPATIAL RELATION) AND CANCER INCIDENCES FROM VARIOUS LITERATURE REVIEWS

This is an attempt to provide a comprehensive synthesis of the published literature on various associations between non genetic factors and cancer incidences. The Meta Analysis of similar studies allowed to generate summary of magnitude of the associations of non genetic factors, information that has been lacking in this area.

A. Methods of Evidence and acquisition and Synthesis

Search Strategy: A broad strategy by searching multiple keywords were used in gathering in formations regarding the contents. The electronic databases of PubMed, CINAHL, Science Direct, ESMO, ASCO, WHO etc. were used in particular.

Eligibility Criteria: The articles which was sorted met the following criteria like;
- Articles published in English
- Reported results from the analysis of original data
- Spatial related environmental articles were given more importance

The analysis includes Factors contributing to Cancer in relation to environment, Background, Results or comments obtained from various articles. Thus the associations are obtained in the form of meta Analysis.

B. Outdoor and Indoor Air Pollution

Ambient air pollution has been implicated as a cause of various health effects, including cancer. It is difficult to define an exposure measure of relevance when the biological mechanisms are largely unknown [6]. There is biological rationale for a carcinogenic potential of numerous components of the air pollution mix, including benzo[a]pyrene, benzene, some metals, particles (especially fine particles) and possibly ozone [7].

Based on the observation of very elevated levels of lung cancer in certain areas of China and elsewhere among females who spend much of their time at home, exposure to indoor air pollution from heating and cooking sources, as well as elevated concentrations of cooking oil vapors arising from certain cooking methods, were recognized as risk variables for lung cancer [6].

C. Radiation Exposures

Exposure to ultraviolet solar radiation is the leading cause of non-melanoma skin cancer, which is by far the most prevalent malignancy in humans. Atomic-bomb survivors were at a considerably higher danger of developing cancer even at small doses of radiation. Increased risk of cancer-specific mortality from medical ionizing radiation exposures include X ray, computed tomography (CT), fluoroscopy, nuclear medicine.

D. Soil Contamination

Contamination is correlated with the degree of industrialization and intensity of chemical substance added to soil [8]. Out of the 900 active ingredients in registered pesticides in the United States, about 20 are found to be carcinogenic and therefore, a number of pesticides have been banned in United States [9]. Some of them include DDT, endosulfan, ethylene oxide, nitrofen, lead acetate etc.

Studies so far do not allow scientists to determine precisely which pesticides are associated with which cancers. For this reason, most of the above-mentioned pesticides are still identified as cancer-causing, rather than as recognized carcinogens in the reports. [8].

E. Drinking Water Contamination

Access to pure drinking water is one of the human health requirements. Water quality is affected by agricultural and industrial discharges, geology and seasons. Microbiological contamination of water is controlled by disinfection methods based on oxidants like chlorine, hypochlorite, chloramines, chlorine dioxin and ozone [6][10].

The understanding of these information is confused by a few components. The concentration of by products in water fluctuates depending upon the presence of organic contaminants, which changes by topographical zone and by season.

F. Indoor Radon

The carcinogenicity of radon decay products has been widely studied in occupationally exposed populations, in particular underground miners. This agent causes lung cancer in humans, but the evidence for an effect on other neoplasms is not conclusive [11]. Despite the reality that exposure levels in houses are less than underground mines, the duration and the number of uncovered individuals emphasize the importance of houses as a source of exposure to radon decay products. A few studies of lung cancer from residential radon exposure have been accounted from some of the articles.

IV. CANCER SCENARIO IN INDIA

India has a rapidly growing population inflicted with cancer diagnosis. From an estimated incidence of 1.45 million cases in 2016, the cancer incidence is expected to reach 1.75 million cases in 2020 [12]. With the limitation of facilities in cancer treatments, the primary effective approach to dealing with the increasing and humongous cancer burden is to focus on preventable cases of cancer. Thus, in their lifetime, one in 8 males and one in 9 females are expected to suffer from cancer (considering a median life expectancy of 74 years). Approximately 70 percent of Indian cancers (40 percent associated with tobacco, 20 percent associated with infection and 10 percent associated with other preventable causes) are triggered by risk variables that can be modified and prevented. [12].
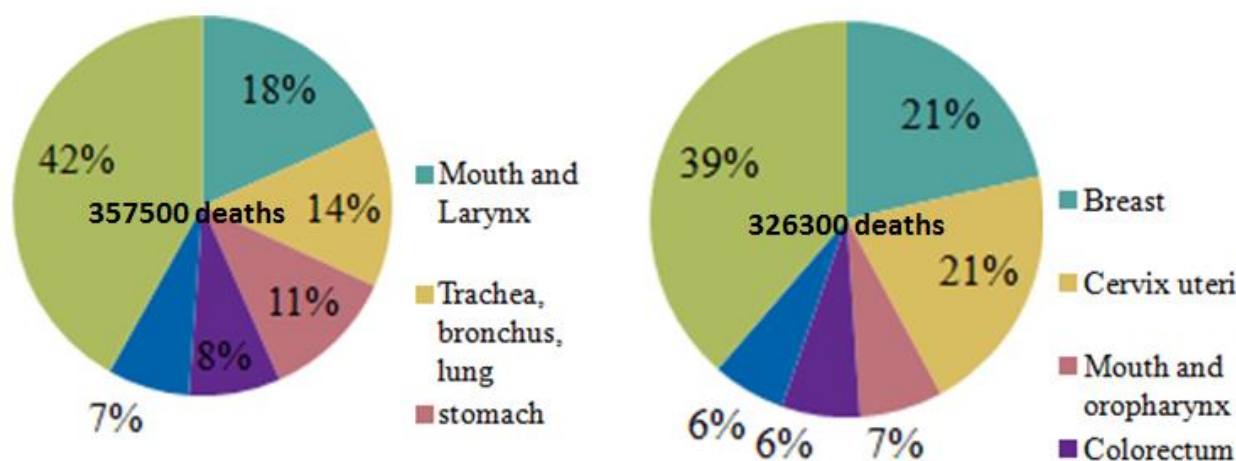
Fig. 5.   *(a) Cancer mortality profile, Males, 2014,*   *(b) Cancer mortality profile, Females, 2014*

Western Population	Indian population
Tobacco smoking(cigarettes and cigars)	Smokeless tobacco in various forms; smoked tobacco
Alcohol(spirits, wines)	Alcohol(local made, spirits)
Red and processed meat	Deep fried, salted fish, spicy fish
Obesity	Obesity
Sun exposure associated cancers	Uncommon in Indian population
Environmental factors	Environmental factors

Fig. 6. *Comparison of the modifiable risk factors for causation of cancer in the western and Indian population*

A. Recommandations

A multi-pronged strategy is required to address India's increasing cancer burden and the best long-term approach could be to necessary for this cause. From the health gain perspective, the immediate priorities of India should include:

- Improving preventive and primary health care facilities in rural areas and North East India
1) Controlled use of tobacco products
2) Indoor and outdoor air pollution
3) Increased public investment in Health care services needs to be a public policy priority in India
4) Better urban planning to provide exercise space
5) Development of health policies that address both communicable and non- communicable diseases
- Public Health spending should also benefit all sections of the society
- India's low spending on public health expenditure is a severe issue. India invests less than 1.5% of its GDP in government-funded and state-funded healthcare, a concern that should be changed
- Tobacco control law and programs need to be prioritized and efficiently enforced across all states

- In addition to government initiatives, advocacy by civil society and efforts of NGO's also needs to be encouraged
- From a patient perspective, The country's progress must be strengthened by focusing on excellent quality access to health care in general, rather than cancer prevention and therapy alone
- The many variations between the states indicate the need for state- specific approaches for cancer control.

V. CANCER SCENARIO IN KERALA

The number of cancer cases that has been reported in recent past in Kerala has raised to a new level, a level that seem to be impossible for the other states like Karnataka and Tamil Nadu can ever imagine to surpass [13]. The number of cancer cases are reported in the state is alarmingly high, and on an average, 35,000 cases are reported every year according to the health department officials [14]. Male population affected about 50% cases are cancer in mouth, lungs and throats due to consumption of tobacco product. According to the data available with the Thiruvananthapuram Cancer Registry, the prevalence rate in rural areas in 19.8 per 100000, while in urban areas, it is 30.5 per 100000 [15]. According to Dr. Mohammed Asheel,

Kasargode district programmer manager of NRHM, most of the cancer cases in Kerala are caused by environmental problems, wrong food habits, hormonal problems and occupational hazards [2].

A. Cancer Data Availability

The data based on Cancer in Kerala is available in three hospital based registries and three population based registries currently. As mentioned above, such registries are very important in determining the cancer control strategies and programs in later run. The Hospital Based Cancer Registries(HBCR) are available in three different regions in Kerala which includes Regional cancer Centre, Thiruvananathapuram(RCC), Amrita Institute of Medical Science, Cochin(AIMS) and Malabar Cancer centre, Thalaserry(MCC).

B. Cancer Incidence Rate in Kerala

Kerala has the highest recorded Cancer cases in India as reported by GBD(Global Burden of Diseases, Injuries, and Risk factors Study) in 2018. In 2016, Cancer incidence rate in India was 106.6 per 1 lakh people, while in Kerala it is 135. 3 per 1 lakh people[16]. As reported by A Nandakumar who is the director of National Centre for Disease Informatics and Research, Indian Council of Medical Research(ICMR), Kerala has comparatively older population to the rest of Indian states which could be a reason for high cancer incidence. And also, Kerala has a well established cancer care centers and organized cancer registry compared to rest of other Indian states were detection is also high. This reason also could be the high count of cancer rates in Kerala.

VI. STUDY AREA

A. Selection Criteria- Kannur District

At present, there are only three Population Based Cancer Registries (PBCR) in Kerala covering Kannur, Kollam and Thiruvananthapuram districts. Malabar region was generally considered to have less development in terms of medical facility compared to South and Central Kerala and largely depended on Mangalore based hospitals for cancer treatments before the establishment of Malabar Cancer Center(MCC), Thalassery. Due to the establishment of Regional Cancer Center(RCC), Thiruvananthapuram in 1981, many studies are conducted in Southern regions of Kerala and Northern part of the state is unexplored. The recent studies conducted by MCC(2001) has established the fact that Kannur is one of the leading sites of cancer in the state.

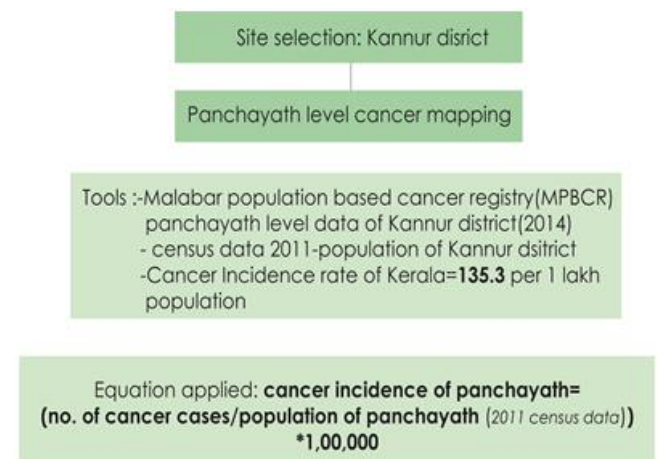### B. Methodology of Cancer Mapping for Kannur District

Fig. 7.*Methodology of Cancer Mapping for Kannur District*

For the cancer mapping of Kannur district, the required in formations was obtained from MPBCR 2014 data which is the only data currently available and Census data 2011- population of Kannur district. The number of cancer patients of each panchayth was provided in MPBCR, which was calculated by the equation in order to normalize the values. According to various studies, Cancer incidence rate of Kerala is 135. 3 per 1 lakh population. Based on this value, the equation was formulated and standardized values was obtained from every 71 Panchayaths of Kannur district.
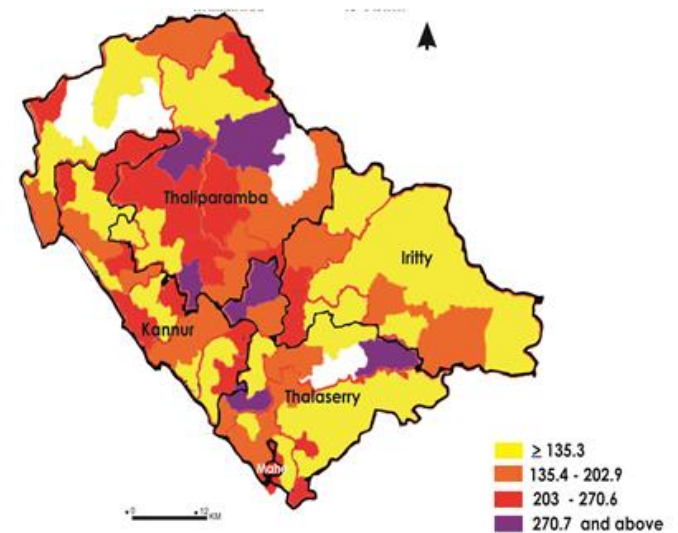
C. Cancer Mapping of Kannur District

Fig. 8. *Cancer Mapping of Kannur District*

D. Results Obtained

Out of 71 panchayaths in the district, the details of 67 panchayaths was obtained were 31 panchayaths(44%) were having the values less than 135.3 which is not prone to cancer and 36 panchayaths (51%) were having values more than 135.3 which are cancer prone panchayaths.
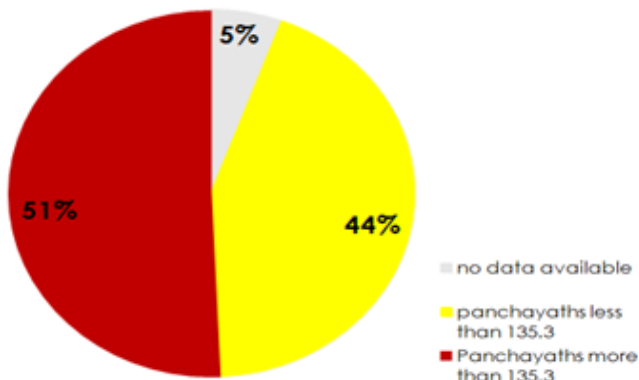
Fig. 9. *Panchayath wise analysis of cancer based on range(135.3) in Kannur district*

As the cancer prone panchayaths are more in number, it was again classified into four categories namely, worst affected (270.7 and above), moderately affected(203-270.6), less moderately affected(134.4- 202.9) and least affected panchayths(>/135.5).
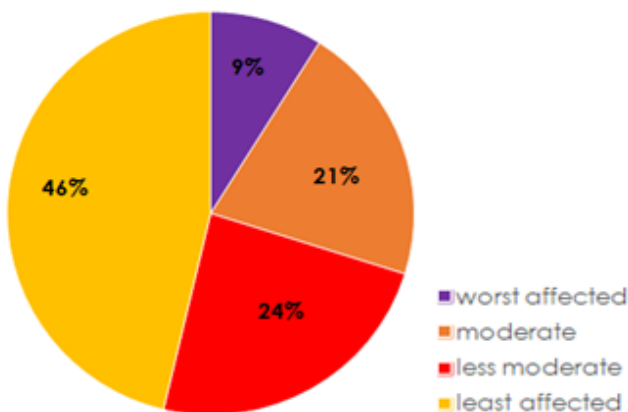

Fig. 10. *Panchayath wise analysis of cancer of 67 panchayaths in Kannur District*

E. Observations and Analysis- Taliparamba Taluk

Based on cancer mapping, Thaliparamba taluk is the cancer prone zone were Naduvil (373.11), Kolacherry (368.52), Chapprapadavu(322.51) panchayaths are top leading panchayaths in the district. Out of 22 Panchayaths(data of 2 panchayaths unavailable) in Taliparamba taluk, only 5 panchayaths are least affected by cancer. Several reasons contribute to this cause were environmental factors and industrial locations are one among them.

1) Air Pollution

The 2 Monitoring locations of Kannur district (Kannur and Mangattuparamaba) has provided a significant rise in air pollution concentration (RSPM).

➢ Result/ Comments:

The Respirable Suspended Particulate Matter (RSPM) values exceeded the permissible level in Kannur district of 60 microgram per cubic metre in 2013 and 2014.
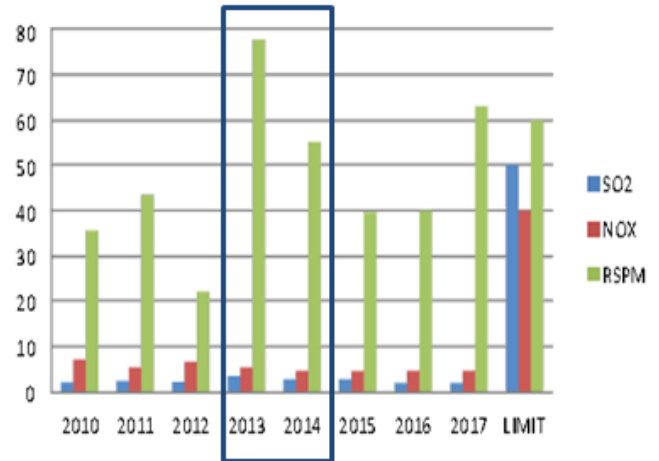

Fig. 11. *Trend Analysis of Ambient air quality of Kannur*

2) Soil Contamination

Although the Supreme Court had banned the manufacturing and sale of endosulfan in India by an order dated 13.05.2011, still it is used illegally in Naduyil(373.11) and Chapparapadavu panchayath(322.51) of Taliparamba Taluk which is a source of Cancer in these areas. There are number of government owned plantations which uses high amount of pesticides currently in the above said panchayaths mainly Cashew, Rubber and Pine apple. Chapparapadavu and Naduvil panchayaths in Taliparamba is the leading producers of cashew, Pineapple and rubber in Kannur district and therefore endosulfan is widely used here.
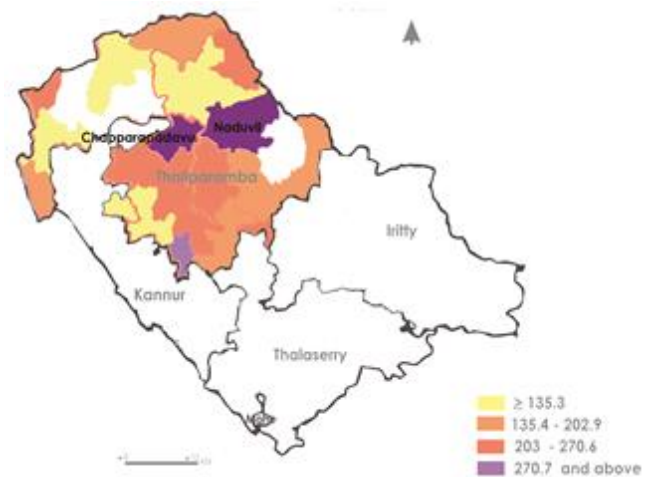

Fig. 12. *Chapparapadavu and Naduvil Panchayath of Kannur district*

3) Water Contamination

➢ Valapattanam River:

The longest river in Kannur district with a length of 110 km. Valapattanam River is well known for its wood-based industries(plywood) situated near to its tributaries especially in talibaramba Taluk . The effluent discharges from the plywood industries and many small industrial units have also contributed to pollution of this river and tributaries. Organic and chemical contamination of surface and groundwater resources in the Valapattanam river,

coupled with dumping of waste and unscientific sewage disposal has raised concerns about serious health hazards for people living in the river basin areas which includes Karumathur panchayath (257.49) in Taliparmaba Taluk [17]. High total dissolved salt values observed in samples indicate pollution stress in the ecosystem of this river. The pesticides and other chemical contents from agricultural areas also flow through Valapatanam river causing serious water borne diseases including Cancer [18]. 53% of surface water, 35% of groundwater samples contaminated with E Coli including Taliparamba Taluk [19]. Presence of salinity and chloride content is found to be exceeding the limits in the samples collected. These results shows that the river is under threat which is a serious cause of diseases like cancer especially in this.
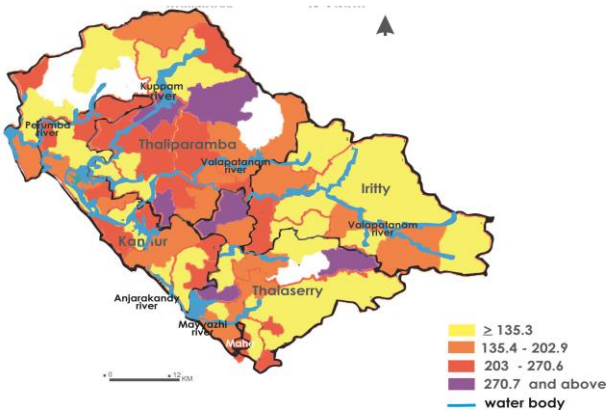
Fig. 13. *Water bodies flowing through Kannur District*

4)   Industrial Influence
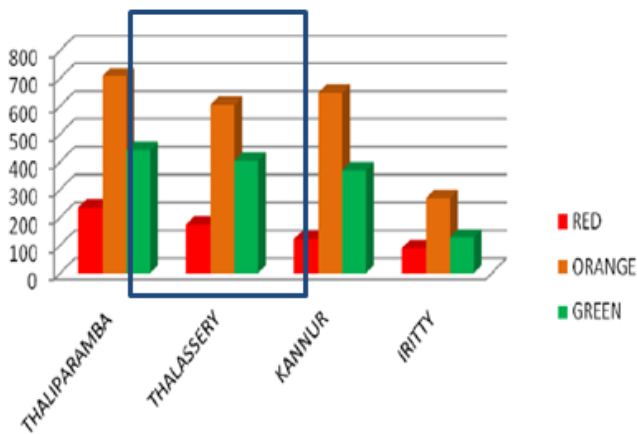
Fig. 14. *Distribution of Industries in Kannur District*

Red Category   : hospitals, gold coverings, textile dye industry
Orange category: Plywood, service stations, hotel, spray painting
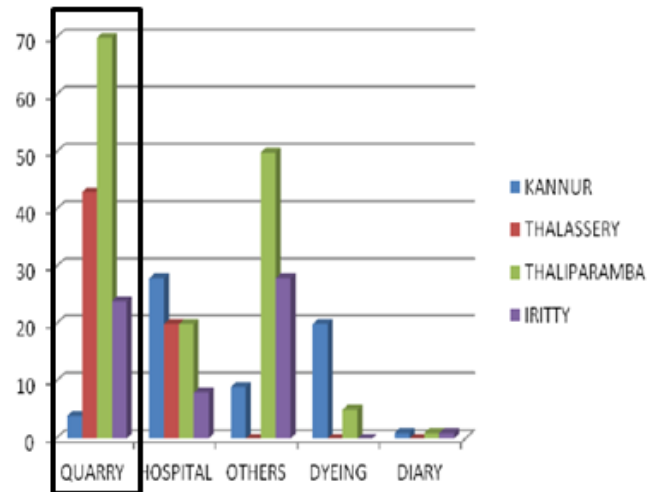Green Category   : mills, interlock, hollow bricks, timber mills etc

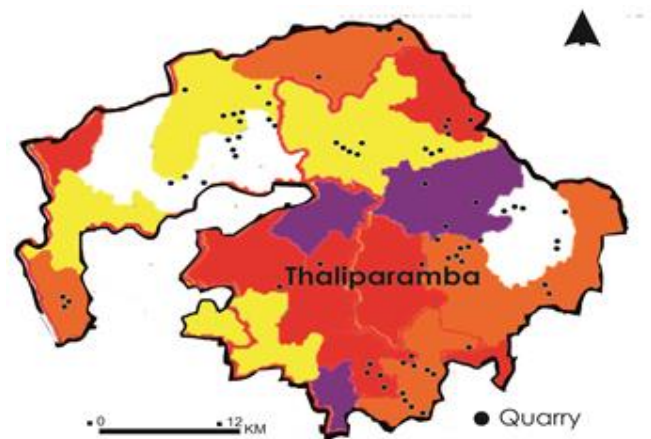Fig. 15. *Red category industries(Taluk level) in Kannur district*
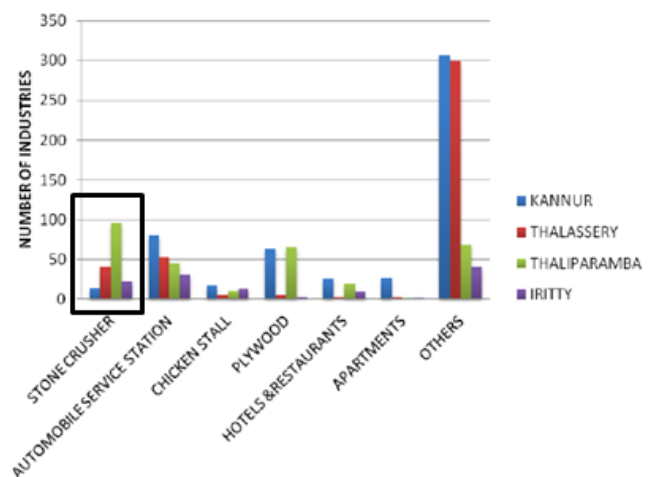

Fig. 16. *Quarries in Taliparamba Taluk*

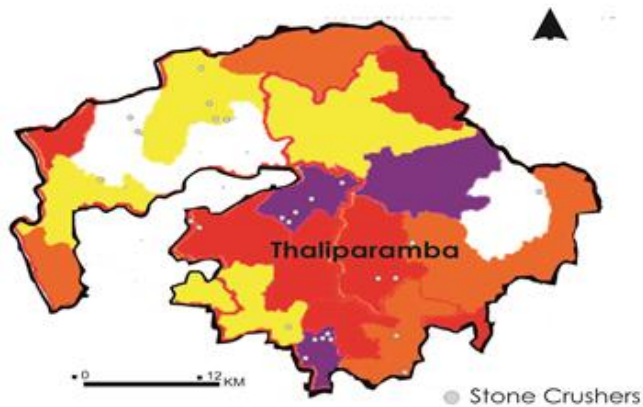Fig. 17. *Orange category industries(taluk level) in Kannur district*

Fig. 18. *Stone Crushers in Taliparamba Taluk*

VII. RECOMMANDATIONS

➤ The stone crushing units of Chengalayi and Chapparadavu panchayaths must be controlled or regulated which is a serious contributor of Lung cancer in this Taluk

➤ As Taliparamba taluk has more number of Quarries and Stone Crushers compared to other taluks, it should be mandatory to avoid further promotion of such growth towards water body as pollution is a serious cause of Cancer in these areas

➤ Endosulfan still used illegally in Naduyil and Chapparapadavu panchayaths should be banned totally

➤ Unscientific sewage disposal of Valapatanam river should be checked and should be the prioritized task of the community and government as a whole
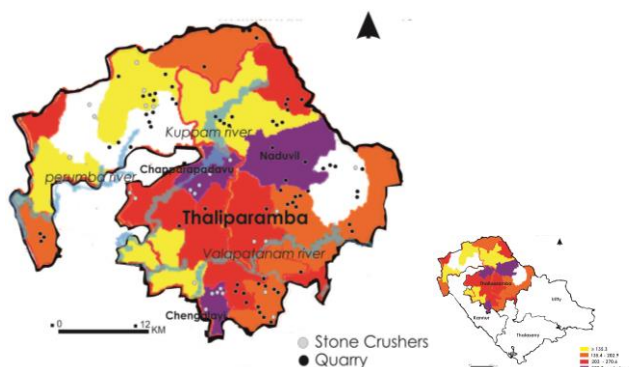

Fig. 19. *Spatial implications of environmental factors causing cancer in Taliparamba Taluk*

VIII. CONCLUSION

In conclusion, this research is an attempt to explore more on the importance of spatial factors and its issues related to Cancer incidences. A shallow assessment of spatial factors were only made possible from available data sources in the primary study and these data helped to arrive at a conclusion that there are modest positive associations between spatial(environmental) factors and cancer incidences. The above study provides an evidence for an appropriate strategical planning to improve our environment in particular with more thorough considerations on public health. A comprehensive planning integrating the existing facilities and taking into consideration, the influencing spatial factors in regional and micro levels in notified areas, can help us in the future in controlling the cancer incidences to a greater extent. Effective study of spatial factors that cause cancer at a detailed level, can help in formulating more recommendations and suggestions in this area of research.

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