Chapter One

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Chapter One

CONCEPTUAL BASE AND METHODOLOGY

1.1 Introduction

Man has always been making efforts to improve his way of life. Inventions and development in the fields of science and technology have brought out tremendous changes in the material efforts making human life easier and more pleasurable. As a living organism, death is inevitable for man. However, during the period of life, man tries to give more importance to the physical well being than the material comforts. Keeping a good health, therefore, has always been a prominent goal in human achievement. No doubt, health and health care delivery are crucial aspects of development planning in any country. Prevalence of diseases pose the most challenging task for an effective healthcare delivery system. The varied combinations of physical parameters make particular diseases to be dominant in particular regions. Disease surveillance and identification of endemic areas are basic characteristics in any health programme. The situation is further complicated by temporal dimension because of changing environmental conditions. Hence in addition to the study of spatial pattern, temporal analysis has also become essential. Thus spatio-temporal analysis has become a valid methodology of geographical research that can be applied to any aspect studied on the earth surface. In the present case, an attempt has been made to consider incidence of malaria as the focal theme of geographical research.

Ever since his existence, man has been affected by diseases. A few of them such as cold are more common and cause less harm. However some other diseases bring irreparable damage to the body which may become fatal. Society was scared of such fatal diseases particularly when they are contagious. Incidence of Plague in the Medieval period resulted in thousands of death. Traditional systems of medicine have been providing relief to many illness. However, diseases such as plague, chicken pox, yellow fever, typhoid and malaria were considered dreaded since there was no effective medicine to check or control them. This situation changed after Industrial Revolution. Better availability of food, improved means of transport, development in science and technology resulted in human achievements in many fields. One such field is the field of medicine where the causes for
many of these dreaded diseases have been understood and counter measures are undertaken to cure them. All the above mentioned diseases are no longer feared due to availability of suitable medicines. However, the world also witnessed emergence of new diseases like cancer and AIDS for which suitable control measures are only in the incipient stage. Inequalities in economic development makes population living in a few areas to be safer than their counterpart in other areas. Since most of the developing countries have large population, provision of proper health care to all is a herculean task. In most of these countries mortality due to diseases such as malaria, tuberculosis, diarrhoea etc is still considerable.

Depending upon the susceptibility of a population to a particular disease, some areas have been considered risky or endemic. Constant surveillance and monitoring are needed in such areas. Surveillance is the systematic collection, analysis, results, interpretation and dissemination of information to facilitate public health action. Surveillance activities include;

- Monitoring disease trends
- Monitoring progress towards disease control objectives
- Estimating the burden of health issues
- Detecting outbreaks of infectious disease
- Evaluating interventions and preventive programs and
- Identifying research needs

Disease surveillance is the systematic collection, analysis, and dissemination of morbidity and mortality data for the purpose of taking action to improve health outcomes. Thus the final link in the surveillance chain is the application of these data to prevention and control. A surveillance system includes a functional capacity for data collection, analysis and dissemination linked to public health programs (CDC 1988). The main purpose of surveillance is to detect changes in trend or distribution in order to initiate
investigative or control measures. Hence surveillance is a continuous process and not restricted to a particular time period.

Twentieth century witnessed the expansion and diversification of surveillance systems. In 1955, the newly-established United States centers for Disease Control (CDC) intensified its active surveillance of acute poliomyelitis cases in order to prove that an epidemic of the disease could be traced to a single vaccine manufacturer. At one point, the CDC was issuing daily reports of the disease (Berkelman et al. 760). A decade later, in 1965, the Epidemic Surveillance Unit was established in Geneva as part of the World Health Organization's (WHO) Division of Communicable Diseases. This unit published its first Communicable Disease Surveillance Report in 1966. While it is often associated with outbreaks of dangerous diseases, in a broad sense, surveillance can be applied to all areas of public health, including injuries, social problems such as drug addiction, mental illness, chronic conditions and cancer (DeChichi and Carter, 1994)

Disease Surveillance Reports are released annually by the WHO for major diseases. These provide not only the spatial pattern of distribution of diseases but also the varied policy measures and preventing technique undertaken in the endemic areas. Among the various diseases, malaria is considered more significant because it is the only endemic disease right from 16th century till date (World Health Organization)

Diseases are caused by bacteria or viruses. Some of them enter human body directly through air, water or food while some other need vector for transmission. Malaria is a vector-borne disease. The female anopheles mosquito is the vector here while human body is the host. Malaria affects the immune system and causes symptoms such as severe fever attacks and anaemia. The P. falciparum type also influences the structure of the blood corpuscles, which results in the bodily tissues being under-provided with oxygen. This can be especially dangerous when it occurs in the brain. P.falciparum causes death if not treated in time. Malaria continues to be one of the most important health problems worldwide. A detailed discussion on various aspects of malaria has been attempted in a subsequent chapter.
As it is a vector-borne diseases, a three pronged strategy is adopted for checking its spread, namely targeting the vector, protecting the host and preventing the occurrence and spread. The first strategy attacks the vector through destruction of breeding sites. It is mostly related to environmental conditions. The vector for malaria breeds mostly in fresh water stagnation. Though most of the initiatives in this regard are taken by the Government, the success depends on the cooperation and active participation of resident population.

The second strategy protects the host from the vector. A verity of measures like fumigation, use of chemical repellents and use of nets checks mosquito biting thereby blocking the transmission. This strategy also includes medication by drug therapy to cure the affected hosts. Role of medical personnel is more dominant in this strategy.

The third strategy involves prevention of occurrence and spread. This depends completely upon the resident population, their attitudes, social structure and economic status. Role of Medical personnel is secondary here while the role of Social Scientists is more contributive in this strategy. Hence it is clear that medical personnel alone cannot provide complete solutions for checking the occurrence and spread of a disease. Research by social scientists on the behavior, social and other parameters is crucial. Geography has played a vital role in this aspect and this has resulted in the emergence of a new subfield called medical geography.

1.2 Medical Geography

Since 1950s, medical geography has been acknowledged as a sub-discipline within geography. The Commission on Medical Geography (Ecology) of Health and Disease presented its first report to the IGU in 1952 (Meade and Earickson 2000). This acquired recognition and subsequently encouragement of the subject was noted in Indian journals from 1951 onwards. Even though the establishment of Medical Geography as a subfield in Geography came after 1950, a number of attempts have been made earlier where the principles of geography have been applied to studies on diseases or health. The ancient Greek physician Hippocrates observed that there was a distinct relationship between human culture, disease, and environment (Nepal, 1998). The unification of health and
geography dates as far back as when humans first realized that their health was linked to the environment in which they lived though there is no concrete date for this realization. Every source of disease is attributable to some aspect of the cultural or physical environment in which we live. In fact, it has been the identification and modifications of these environments that have allowed modern medicine to progress from simple theories of miasmatic disease origin to such complex discoveries as the identification of specific host cell ligands and receptors that allow entry of Human Immunodeficiency Virus (HIV) into lymphocytes (Kumar et al., 2004).

The discovery of the “germ theory” in the early nineteenth century was so profound that it enabled physicians and scientists of the time to enter into a new world of medical investigation that was to fatefully change and alter the course of human health (Haynes, 2001). The pivotal point in the evolution of medical geography came in 1854 when the renowned English physician John Snow pioneered the idea that ecological phenomena can be cartographically matched to health events, correlating cases of cholera to water supply structures within London using maps (Newsom, 2006). Snow was simply applying the concepts of geography to control a disease based directly on the results of a spatial analysis. Because his work showed for the first time that geography can play a primary rather than supportive role in the explanation of many diseases, he is considered the father of modern medical geography (Barrett, 1996).

The interest in disease mapping and the large number of maps that were produced during the late 18th century and the first half of the 19th century inspired Gilbert (1958 cited by Paul 1985) to label this period as the ‘golden age’ of medical cartography. After 1950, many of the works in medical Geography brought out spatial pattern of diseases and their relationship with environmental factors. The World Health Organization (WHO) redefined the concept of health to include not only the absence of disease but also the state of complete physical, mental, and social well-being (WHO, 1946). Consequently the focal theme of Medical Geography broadened to encompass health and health care into its fold. Provision of health care depends more upon initiatives by the Government rather than on private medical practitioners. Public health care delivery system has been established in all countries. However they become more crucial in Developing countries.
Various factors affect the efficiency of health care delivery and like any other phenomenon, there has been spatial variations making it an ideal area for geographical research. Increasingly, medical scholars are seeking the assistance of geographers while geographers are venturing into the realms of health research (Johnston & Williams, 2003). Since the concept of health includes diseases, the term Medical geography has been slowly modified so that ‘Geography of Health’ became more prominent at present.

Early 1970s brought awareness with regard to environment and the need of conservation while the era of globalization began in the late 1980s. Both these dimensions coupled with revolutionary changes in the field of transport and Communication resulted in the shrinking of Globe as a ‘village’. Technology advancement helped all fields and health care is not an exception. While the development of Remote Sensing helped easier collection and update of data for any area of the earth, the GIS provide viable and faster means of processing the huge volume of data. Consequently application of Remote Sensing and GIS has opened new vistas in all the sub fields of geographical research including health. Armed with such sophisticated technologies like Remote Sensing and GIS, Geography of Health has indulged in new and sophisticated methods of data collection, data manipulations and spatial analysis which are of more practical value in health care planning. As already indicated, more number of regional studies is the need of the hour for planning an effective health care delivery system. The present study is one such attempt in which the status of health care delivery is assessed with reference to a disease namely malaria in an endemic area.

Having discussed a broad outline about the conceptual base for the present study, it is not out of place to discuss the various earlier empirical investigations on the chosen theme here.

1.3 Earlier Empirical Investigations

As noted earlier, malaria has been studied both by medical professionals and social scientists. Research work done by medical personnel is beyond the purview of this present investigation and they have not been considered. Research work pertaining to the spatial analysis and environmental considerations on malaria alone are taken for the present study.
As an endemic disease, malaria affects mostly parts of Africa and Southeast Asia than the other areas of the world. Hence most of the studies concentrate on these areas.

One of the most important and pioneering works on the study of malaria from a geographical perspective was given by Medvedkov (1968). Giving an elaborate account about the geography of malaria, they traced the dynamics of spread of malaria in the world. They also classified the world into Holoendemic, Hyperendemic, Mesoendemic, hypoendemic, epidemic and malaria free regions thus providing a vivid spatial analysis of the disease.

Nualchawee (1997) tried to identify the relationship between vector borne disease and vegetation Cover in Chanthaburi Province of Thailand. They used Normalized difference vegetation index (NDVI) calculated for NOAA satellite coverage's of Thailand. LANDSAT TM image used to produce the land use map of the province. Impact of density of vegetation on vector density is discussed.

Lindsay and Martens (1998) analyzed about the status of Malaria in the African highlands from earlier period to till date. The results obtained are fit into a mathematical model designed to identify the epidemic-prone regions in future and the differences which may be expected to occur as a result of projected global climate change. They recommended that a regional modelling approach should be adopted to assess the extent and severity of this problem and help improve disease surveillance and the quality of health care delivered in this unstable ecosystem.

Mayer (2000) analyzed the major characteristics of emerging diseases, in an interdisciplinary context. He has related geography, ecology and emerging infectious diseases. He discussed about the air-borne, food and water-borne diseases and disease diffusion through trade and transportation, migration and climatic change.

Lindblade et al (2000) made an attempt to study the increasing high elevation malaria transmission in African highlands with particular reference to Uganda. They investigated the effect of land use change on malaria transmission in the southwestern highlands of Uganda.

Claborn (2001) used Remote Sensing and GIS as Decision-making Tools for control of malaria in the Republic of Korea and compared the cost of mosquito larviciding to that of chemoprophylaxis for the control of re-emerging malaria on two U.S. Army camps in South Korea. They found that Remote sensing and GIS allow the user to extrapolate local mosquito surveillance data to a regional scale, thus providing cost comparisons for multiple human population centers that would not otherwise be surveyed.

Kaya (2002) used Radar Remote Sensing for identifying environmental factors associated with malaria risk in Coastal Kenya. Land use classification, Texture analysis and buffering were used. The wetland class was considered to be most conducive to larval breeding. With this information, a risk map was generated to show the populated areas that lie within the two kilometre buffer zone around the wetland areas.

Rodriguez et al (2003) tried to assess the knowledge and beliefs about malaria transmission and practices for vector control in southern Mexico. The study shows that women had a greater participation as family health promoters, with 70% of the housewives being in charge of the application of self-protection preventive measures. Increasing awareness on the role of mosquitoes on malaria transmission could promote better community participation in malaria control in the region.

Sithiprasasna et al (2003) used Remote Sensing, Geographic information system and spatial modelling to study the distribution of malaria mosquitoes in northwestern Thailand. They analyzed the topographic variability and its control over soil moisture heterogeneity and runoff within a watershed. The model resolves small areas of surface wetness and permits identification of the spatial distribution of potential breeding habitats within a catchment. The relationships between larval and adult mosquito distribution and observed malaria distribution have been correlated.

Anderson (2003) explains the utility of a Malaria Information System (MIS) applying the principles of GIS. MIS helps to increase the efficiency of various programmes on malaria control in an economic and better way.
Peng Bi et al (2003) conducted a time series analysis of climatic variables and correlated them with transmission and incidence of malaria. A strong positive correlation has been indicated in this study on Shuchen country in China.

Klinkenberg et al (2003) analysed spatial and temporal risk regarding malaria incidence and land use in Southern Sri Lanka. They have used malaria-incidence rates, land- and water-use patterns, socioeconomic features and malaria-control interventions by geographical information system. Malaria cases were mapped at the village level. Relative risks for different variables were calculated employing multivariate analyses. Areas of high malaria risk were characterized by a) more than average rainfall, b) a large forest coverage, c) chena (slash-and-burn) cultivation, d) the presence of abandoned tanks, and e) a poor socioeconomic status. Malaria risk maps can form a convenient tool for discussion with control personnel and for assisting them in targeted and cost-effective interventions.

Rattanasiri et al, (2004) applied Mixture Model technique for Disease Mapping of Malaria in Thailand for three years. This study also attempted investigate the dynamic nature of malaria in Thailand during the 3-year time frame by applying the space-time mixture model. The advantage of the mixture model approach to disease mapping is the graphical visual presentation of the prevalence of disease. The space-time mixture model more adequately investigates the dynamic nature of disease than does the mixture model.

Kittayapong (2005) attempted to identify the control measure for both malaria and dengue vector in Southeast Asia. Dengue control programmes in Southeast Asia have recently shifted from application of insecticides to integrated vector control strategies using biological control agents, pyrethroid-based insecticides, source reduction and environmental management. However, most of the present vector control measures are not sustainable due to several factors related to both community participation and persistence of public-health vector control programmes. Genetic control using modern molecular technologies may offer novel solutions for future control of vector-borne diseases.

Kazembe et al (2006) attempted spatial analysis and mapping of malaria risk in Malawi using point-referenced prevalence of infection data. Bivariate models showed a significant association of malaria risk with elevation, annual maximum temperature,
rainfall and potential evapotranspiration. The map provided an initial description of the geographic variation of malaria risk in Malawi and might help in the choice and design of interventions which is crucial for reducing the burden of malaria in Malawi.

Legesse et al (2007) considered the incidence of malaria in western Ethiopia. It is found that the level of knowledge of the role of mosquitoes in malaria transmission and comprehensive knowledge about malaria prevention strategies among the study population were only 50%. Need for comprehensive behavioral change and improved communication is discussed.

MacLachlan (2009) expressed the urgent need for integrative expertise in global health research which facilitates better research utilization, helping policy makers and practitioners to work through more evidence-based practice and across traditional research boundaries.

Chang et al (2009) utilized Google Earth with GIS for developing a dengue surveillance system for developing countries. They found that this program is well-suited for resource-limited settings since it utilizes readily available technologies that can easily be implemented in many developing countries for very little cost.

High resolution IKONOS data of an endemic malaria lowland in western Kenya was used by Mutuku et al (2009). The association between land cover and the breeding sites of anopheles mosquito are elaborately explained.

Yeshiwondim et al (2009) investigated the spatial analysis of malaria incidence at the village level in areas with unstable transmission in Ethiopia. Malaria incidence varies according to gender and age, with males age 5 and above showing a statistically higher incidence. Malaria hot spots are displayed as risk maps that are useful for monitoring and spatial targeting of prevention and control measures against the disease.

Castronovo et al (2009) brought out the advantages of dynamic maps for health research. Dynamic mapping is a practical visual-analytic technique for public health practitioners and has an outstanding potential in providing insights into spatio-temporal
processes such as revealing outbreak origins, percolation and travelling waves of the diseases, peak timing of seasonal outbreaks and persistence of disease clusters.

Howard et al (2010) tried to present a method of analysis of field malaria data. Malaria studies were carried on in seven main areas Puerto Rico island, in one of which no control activities were attempted. The other six areas were divided into "inside" and "outside" zones. In the "inside" zones experimental measures were employed. "Outside" zones, as near as possible to the "inside" zones but beyond the limits of the work, served as controls. The data bearing on these points fell into three classes: A. The incidence of malaria, in numbers of cases per month. B. Intensity of mosquito breeding, in monthly average numbers of larvae and pupae per dipping period. C. Density of adult mosquito prevalence, in monthly average catches per animal-baited trap per night. Statistical analysis is carried out to bring out the relationships among the three groups of data as well as the impact of ‘control’ areas on ‘inside’ zones.

Rakotomanana et al (2010) used a geographical and environmental approach to investigate the contribution of environmental factors to urban malaria in Malagasy. Remote sensing data were used to locate rice fields, which were considered to be the principal mosquito breeding sites using supervised classification. Entomological study allowed vector species determination from collected larval and adult mosquitoes. A geographical information system was constructed for data integration. Altitude, temperature, rainfall, population density and rice field surface area were analyzed and the effects of these factors on the occurrence of confirmed malaria cases were studied.

Dery et al (2010) analyzed the patterns and seasonality of malaria transmission in the forest-savannah transitional zones of Ghana. Knowledge of the local pattern of malaria transmission and the effect of season on transmission is essential for the planning and evaluation of malaria interventions. The dynamics and seasonal abundance of malaria vectors in the Kintampo area was influenced by micro-ecology, rainfall and temperature patterns. Transmission patterns did not differ significantly between the two years (2004 and 2005). The information provided by the study will help in planning intensified malaria control activities as well as evaluating the impact of malaria interventions in the middle belt of Ghana.
Investigating the re-emergence of malaria in Huang-Huai River of central China, Zhou (2010) indicated that distances from household of cases to the nearest water-body was positive-skew distributed; the median was 60.9 m; and 74% malaria cases were inhabited in the extent of 60 m near the water body and the risk rate of people live there attacked by malaria was higher than others. The annual average temperature and rainfall may have close relationship with annual incidence and are the key factors. The spatial distribution between malaria cases and water-body, the changing of meteorological factors, and increasing vectorial capacity and leaded to malaria re-emergence in these areas.

India is one of the important countries affected by malaria in the World. Since its total population is large, endemic areas have a comparatively larger population under the risk category. A number of earlier investigations have also been carried out in India about malaria by social scientists.

Covell et al (1927) presented a critical review on the various species of anopheles mosquito which is the vector for malaria. They provided a detailed account on the characteristics, breeding sources and spatial distribution of each of these species. This work provides a detailed account on Indian territory with regard to anopheles species.

Gupta (1950) had done a historical review of the knowledge of malaria and the methods of control in India. A detailed account was given about parasite, transmission and host through various aspects which include physical factors (topography, soil, and climate), demographic factors (age, gender, literacy and migration) and natural disaster factors (famine, flood, drought and cyclones). The case of man-made malaria through activities like agriculture has also been investigated.

Mutuwatte et al (1997) assessed the spatio-temporal relationship between malaria and selected water-related environmental factors such as rainfall, rice intensity, ground water, irrigation density using GIS. They found that rainfall and rice density correlated with seasonal parasite incidence in Mahi Kandna in Gujarat.

Rema Devi (1999) focused the environmental conditions (physical and socio-cultural) of Valiyathura in Thiruvananthapuram city which make the population of the area
susceptible to infection of malaria. An appraisal of the existing control strategies being pursued in this area by public authorities has also been made.

Reid (2000) has discussed the implication of climate change on malaria in Karnataka. API trends between districts in Karnataka and of the different climatic regions within the State due to the effect of topography have been analyzed. He has considered API and SPR as major factors and they had strong correlation with climatic parameters.

Jeganathan et al (2001) used Remote sensing and GIS to find out the characterization of malaria vector habits by using climatic factors and topographical factors such as flood, soil land cover (forest classes) etc in North Lakhimipur and Dibrugarh districts of Assam.

Rajiv Gupta et al (2003) attempted to find a common methodology to identify the vulnerable areas of infectious disease using GIS. Listing out the aetiology and epidemiology of 50 infectious diseases, they tried to identify vulnerable areas. They also cautioned that the success of methodology depends upon accuracy of data.

Sharma (2003) reviewed the relationship between poverty and malaria in the last three decades that shows a clear divergence, i.e. declining trend of malaria in well-performing States and a reverse situation in States whose economy continued to be stagnant. He has quoted that the real malaria situation in States BPL is appalling in the three highly populated states namely Bihar, Uttar Pradesh and West Bengal. Improvement in the prevailing malaria situation requires a determined effort at the highest level of governance to make a difference. Key to malaria control lies in understanding local malaria with a primary attack on poverty and malaria receptivity.

Srivastava (2004) conducted a GIS-based study in Mewat region which is an integral part of traditionally known malaria epidemic belt of the Northwestern Plains of India. The study used ecological parameters at block level and their utility to study the impact on transmission dynamics of malaria through GIS mapping. They suggested that there is a need to strengthen surveillance in these areas and pay special attention to these pockets.
Panda and Mohapatra (2004) attempted an overview of malaria control in India. They found that the major reason for resurgence of malaria in many part of the country is due to migration, lack of awareness and the lacunae in health care delivery. They suggested that community participation and their awareness about the diseases is more important for eradication of malaria.

Sharma et al (2004) described the seasonal epidemiology of malaria in San Dulakudar, a village in Sundargarh District in the state of Orissa in eastern India. Transmission intensity varies with season with high transmission after the monsoon rains in autumn and winter, low transmission in summer and intermediate transmission in spring. San Dulakudar can be classified as a hyperendemic area for P. falciparum malaria.

Aruna Srivastava et al (2005) attempted to predict of the distribution of malaria vector in forest fringe areas using GIS. Precision field surveys which were conducted provided the validity and advantages of GIS as an effective tool for malaria control. They also suggested that it can also delineate areas favourable for any species of flora and fauna to help precision surveys.

Tyagi et al (2005) tried to assess the level of knowledge, awareness and practices towards socio economic groups of population in rural, semi-rural and bordering areas of East Delhi. The need for more research in awareness levels by social scientists is stressed.

Krishnamoorthy et al (2005) tried to assess the altered environment after tsunami in Andaman island and the risk of malaria outbreak. Land uplifts in North Andaman and subsidence in South Andaman have been reported and subsidence may lead to environmental disturbances and vector proliferation. Paddy fields and fallow land with freshwater, are now major breeding sites due to saline water. Consequently, there is a risk of vector abundance with enhanced malaria transmission potential, due to the vastness of these tsunami-created breeding grounds and likelihood of them becoming permanent due to continued flooding in view of land subsidence. The close proximity of the houses and paucity of cattle may lead to a higher degree of man/vector contact causing a threat of malaria outbreak in this densely populated area. Measures to prevent the possible outbreak of malaria in this tsunami-affected area are discussed.
Bhattacharya et al (2006) try to find out the influence of climate change on vector production and malaria transmission in India. They analysed the present climatic trend and corresponding malaria incidences by using of a set of transmission windows typical to India in terms of different temperature ranges for a particular range of relative humidity. The same criteria under the future climate change conditions in 2050s also.

Pawar et al (2008) assessed mosquito breeding, vector control measures and treatment seeking behaviour in selected slums of Surat city after the most devastating flood on 2006. The study also focuses on the need to change the treatment seeking behaviour pattern of fever cases among the slum dwellers.

Sharma (2009) tried to assess the burden of malaria in Indian women. A recent study on malaria in pregnancy reported from undivided Madhya Pradesh state (includes Chhattisgarh state), that an estimated over 220,000 pregnant women contract malaria infection each year. Malaria in pregnancy caused 34.5% abortions, 9% stillbirths and maternal deaths. Malaria in pregnancy may quicken severity in patients with drug resistant parasites, anaemia, endemic poverty, and malnutrition. There is, therefore, an urgent need to streamline malaria control strategies to make a difference in tackling this grim scenario in human health.

Srivastava et al (2009) attempted to identify of malaria hot spots in the forested and tribal area of Madhya Pradesh, India using GIS. They found that GIS mapping would make it easy to update information instantly and to identify the trouble spots at the village level within the district which is the lowest unit equipped with computer facilities and the information can reach instantly to state and the policy makers to formulate focused and cost effective malaria control strategy.

Prasad (2009) evaluated the status of malaria control programme in three selected districts of Assam. The results revealed that the malaria control programme had been jeopardized seriously due to improper implementation of vector control measures, lack of adequate professional support and varied commitment on the part of the State Government. He suggested that long-term malaria control strategy should be based on generation of
increased awareness on the disease and various methods of its control, health care access and administrative commitment for increased prosperity in resource-poor settings.

Cohen et al (2010) used the Summary Index of Malaria Surveillance (SIMS) which is a stable index of malaria within India. The SIMS correlates positively with all its individual components such as API, SPR, ABER, SPR and SFR and with external measures of mortality and morbidity. It is highly consistent and stable over time (1995-2005) and regions of India. This measure should provide a useful tool for researchers looking to summarize geographic or temporal trends in malaria in India and can be readily applied by administrators with no mathematical or scientific background. They include a spreadsheet that allows simple calculation of the index for researchers and local administrators. Similar principles are likely applicable worldwide, though further validation is needed before using the SIMS outside India.

Dev et al (2010) analyzed the reasons for persistent transmission of malaria in Garo hills of Meghalaya bordering Bangladesh. Investigations revealed that malaria transmission was perennial and persistent with seasonal peak during May-July corresponding to months of high rainfall. Entomological collections revealed that Anopheles minimus was the predominant species.

Dua and Acharya (2013) analysed current strategies for malaria control in India. Malaria still continues to be a public health problem in India. For adequate control strong inter-sectoral coordination with a good political commitment is needed for effective implementation followed by appropriate monitoring and evaluation of programme. Multicentric studies need to be planned to fill the information gaps. In addition, there is a need to do a situational analysis and find out appropriate solutions to various challenges and practical issues that are present before /during the implementation process.

Studies on malaria in Tamilnadu from the perspective of social sciences is almost nil.

Hyma et al (1985) provided a review of urban malaria control situation and related environmental issues in Tamil Nadu. This study examines urban malaria/vector control schemes in the ten seriously affected urban areas in the State of Tamil Nadu for the period
1974 to 1984 and some of the factors contributing to malaria resurgence of the 1970s in the State.

VCRC (1986) prepared a report on the persistence of malaria transmission in Rameswaram island giving details of breeding sites, population movement and the reasons for continued incidence of malaria in Rameswaram island.

Balakrishnan (2003) used of GIS for the malaria distribution mapping in Chennai. A simple malaria control system, based on the concepts of GIS, has been designed to support malaria control activities in Chennai. He used GIS to develop spatial and non-spatial data, to identify low and high-risk zone and reasons, assist planning and implementation of control measures and monitor and evaluation of control measures.

Thus studies on malaria in Tamilnadu from the perspective of non-medical aspects are very limited. The present investigation is one attempt to fill up a small part of this huge void.

1.4 Choice of the Study Area

Ramanathapuram district is located in the southeast part of Tamilnadu where semi-arid climate is prevails. Among the rural Tamilnadu it ranks first in the incidence of malaria. It should be noted that this incidence is dominant for almost 2 or 3 decades. Even within Ramanathapuram district, only few blocks have concentration of affected patients. On the whole, 90% of the total malaria incidence is concentrated along the coastal blocks. Since there is no specific study providing a spatiotemporal dimension to this endemic disease, the present study has chosen the coastal blocks of Ramanathapuram district as its study area. Some of the areas here continue to have very high API score in spite of the efforts taken by Health Department. Hence there is an urgent need to study about the status of health care delivery with particular reference to malaria in the study area. Thus the present investigation attempts to provide some insight into the problem of endemic malaria so that effective planning strategies may be evolved.
1.5 Aims and Objectives

The purposes of this research were to describe the epidemiology of malaria in Coastal blocks of Ramanathapuram district a 10-year span; to retrospectively analyze environmental risk factors of malaria at national and local scales; to increase knowledge of malaria transmission patterns; and to aid in area-specific malaria control efforts. The objectives of this research were:

- To analyze the spatial pattern of malaria incidence in the study area;
- To bring out the temporal changes in the selected two time points of 2001 and 2010;
- To assess the seasonal distribution of malaria incidence by region;
- To examine correlations of malaria incidence with living environmental factors;
- To examine correlations of malaria incidence with socio economic factors;
- To assess the correlation of land cover using remote sensing and Geographic Information System (GIS) technologies, with malaria incidence from 2001 to 2010 in the coastal blocks of Ramanathapuram district;
- To assess the association of household and peri-domestic factors with malaria risk in families in the study area.

1.6 Methodology

1.6.1 Source of Information and Database

For the present study both primary and secondary data have been collected. Secondary data of disease surveillance data PHC wise between the study periods of 2001 - 2010 have been collected from the annual report of NVBDCP in Ramanathapuram and Paramakudi DPH. From the report required data have taped PHC wise as total number of positives, gender, age structure and seasonal pattern. API and SPR are calculated and represented spatially. The study area details are collected from the District Statistical Department. Demographic data regarding different aspects have been provided by the
Census of India (2001) and it includes data regarding total population, sex, literature and workers in different sectors. The Remote sensing data for the study area is generated from LISS III of Resource sat in the 24 meter resolution.

The primary data has been collected through systematic stratified random sampling. Out of 34 PHCs are grouped in to five categories. Based on the five categories nine sample PHCs were selected. Questionnaire was formulated based on the disease surveillance system recommended by CDC. Then it is restructured based on the localities of study area and pilot survey was conducted. Again the questionnaire was restructured for main surveys in nine PHCs. In every PHC 2% of the total households were contacted at random.

1.6.2 Techniques used in the Present Study

The present study used the simple cartographic and statistical techniques. Unsupervised classification used along with clutter techniques in ERDAS 8.3 for land use classification. The systematic stratified random sampling is used for primary data collection. The generated data is tabulated and analyzed. The results are represented through suitable cartographic techniques. SPSS 19 was used for extracting principle components to bring out the controlling factors. Thematic mapping layers for results are generated using ARCGIS 9.3 environment.

1.7 Limitations of the Present Study

The present study used only secondary data for incidence of malaria (2001-2010) which collected from the Deputy Director of Health Services of Ramanathapuram and Paramakudi Health Unit Districts under the Directorate of Public Health and Preventive Medicine, Chennai.

As a social scientist the present study considered only the API and SPR parameters malaria surveillance. Similarly Census 2011 results are not published till date. Since population projections may not be accurate, only 2001 census data was taken. For malaria incidence, the total population indicated by Health Department for 2010 was taken.
1.8 Organization of the Thesis

The thesis is organized into seven chapters.

The first chapter provides the conceptual base for the present study. It also discusses earlier empirical investigations, choice of study area, aims and objectives, data sources, techniques and limitations. A brief note on cauterization is also given.

The second chapter describes the location of the study area, physical conditions, demographic conditions, land use pattern and transportation.

The third chapter summaries the relationship between the disease, social science and medical geography and the role of Social Scientist in Health care services is explained. Worldwide timeline for the spread of malaria is also reviewed. The clinical and spatial aspect of malaria and World malaria pattern based on the WHO regions is discussed. The Indian situation is also explained in this chapter.

The fourth chapter provides the status of malaria in Ramanathapuram District and the methodology of study. The first time point of 2001 is taken and the spatial pattern of the incidence is discussed through number of cases, API and SPR parameters.

The fifth chapter provides the status of malaria incidence for the second time point of 2010 and it also brought out the temporal changes during the study period.

Sixth chapter is devoted for the analyses of primary data which is divided into socio-economic dimension, supply of drinking water, living environment, perception regarding malaria disease, control measures and effectiveness of health care delivery system. Factor analysis is carried out for the selected components in the primary data.

Summary and conclusion, findings and recommendation were given in the seventh chapter.