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Spatio-Temporal Distribution of Malaria in the Tribal Region of Visakhapatnam District, Andhra Pradesh, India.

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ABSTRACT: Human malaria can be caused by different species of Plasmodium parasites. P. falciparum (P.f) and P. vivax (P.v) are the most important species accounting for more than 95% of cases worldwide cases and remaining species are P. Malaria, P. Knowlesi, P. Ovale Wallikeri and P. Ovale Courtisi. Plasmodium falciparum is the most severe form of the disease in Africa, accounting for more than 90 percent of malaria cases. The malaria parasite is transmitted by a female Anopheles mosquito, which injects sporozoites into the human host. Among vector-borne diseases, malaria shows widespread prevalence, making it one of the highest morbidity and mortality rates worldwide. According to the World Health Organization (WHO), in 2016 about 216 million people were infected and 445,000 were killed by malaria. The majority (90%) of Malaria cases are reported in Africa, although the disease is distributed in 91 countries worldwide. India contributes 61 per cent of malaria cases and 41 per cent of malaria deaths in SEAR countries .In 2014, about 181.3 million people in India lived in high malaria prone area. Majority of Malaria cases in India were recorded in Hilly and Tribal region. In this background an attempt is made in this paper, to study the spatiotemporal changes of Malaria disease in the Tribal region of Visakhapatnam district and this study will be useful for DM&HO Visakhapatnam to take care to provide health care facilities in the Tribal region of Visakhapatnam district.

Index Terms - Malaria, P.v Malaria, P.f Malaria, Tribal region, Malaria case.

I INTRODUCTION:

Human malaria can be caused by different species of Plasmodium parasite. P. falciparum (P.f) and P. vivax (P.v) are the most important, accounting for more than 95% of cases worldwide and remaining species are P. Malaria, P. Knowlesi, P. Ovale Wallikeri and P. Ovale Courtisi [13] P. falciparum is the most severe form of the disease in Africa, accounting for more than 90 percent of malaria cases. For this reason, it is the best-classified species [14]. However, in recent years, severe infection caused by malaria P.vivax is gaining importance [15]. In addition, P. vivax has recently gained a great deal of attention because it is the largest geographically distributed species in Latin America, the Middle East, Southeast and Southeast Asia, the Horn of Africa and Oceania [16]. The malaria parasite is transmitted by a female Anopheles mosquito, which injects sporozoites into the human host [18]. Sporozoites reach human liver cells, where they transformed into a merozoite. The merozoite reaches the erythrocytes, through the bloodstream, and multiplies to form new merozoite. Some merozoite released after the breakdown of erythrocytes are converted into chemotocytes.If the Anopheles mosquito bites an infected person, the merozoites re-enter it. Inside the mosquito, in its midgut, sexual reproduction takes place, forming zygotes and developing into oocysts. As they grow and break down, mosquitoes release sporozoites that invade their salivary glands. Among vector-borne diseases, malaria shows widespread prevalence, making it one of the highest morbidity and mortality rates worldwide. According to the World Health Organization (WHO), in 2016 about 216 million people were infected and 445,000 were killed by malaria [3]. The majority (90%) of Malaria cases are reported in Africa, although the disease is distributed in 91 countries worldwide. The World Health Organization estimates that there were 207 million malaria cases worldwide in 2012 (135-287 million uncertain) and 6,27,000 deaths (uncertainty range 4,73,000-7,89,000); About 80 percent of these cases are in Africa and 13 percent in Southeast Asia (SEAR) countries [7]. India contributes 61 per cent of malaria cases and 41 per cent of malaria deaths in SEAR countries [8].In 2014, about 181.3 million people in India lived in high malaria –prone area [21]. 80% of Malaria cases in the country are in areas where 20% of the population lives- Tribal and Hilly [22, 23].Outside the African continent, India has the highest number of malaria deaths, at 200,000 annually [24]. About

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50% of malaria deaths in India occur among members of tribal groups [25]. Since less than 10% of the total population of India is tribal, these groups carry the highest disease burden. Therefore, malaria is an issue that is not limited to certain regions or countries and it is a global challenge for all mankind in the 21st century. A good example of this is the fact that in 2016, the governments of malaria-affected countries and their international partners (such as the United States and Germany) invested about $ 2.7 billion in its elimination (most of these resources, about 74%, were invested in Africa) [3]. Malaria is one of the most highly contagious arthropod-borne diseases in China's mainland. The National Surveillance Program reports that more than 740,000 malaria cases were detected in 907 districts of 18 provinces in 2003 [6]. Malaria is a major public health problem in India that can be prevented and treated.

Climate factors such as temperature, humidity and rainfall play an important role in the spread of malaria [1]. The most dangerous areas are forest, forest margin, foothills, river belts, mountains and river valleys. The incidence of malaria has decreased in districts regardless of whether vector control interventions (i.e., implementation of indoor residual spraying (IRS) and long-term pesticide nets distribution (LLN) have been implemented [2].Tribal people in India mostly live in remote and inaccessible areas due to the usual geological conditions due to forests, mountains, valleys and perennial streams [9,10].The presence of various malaria parasites and vector species, favourable climatic diversity for parasite and vector growth and proliferation, and the highly vulnerable human population contribute to the high prevalence of malaria in tribal areas [9,11].The use of health services is bad among the tribal population and they have inherited health beliefs. [12]

II OBJECTIVES:

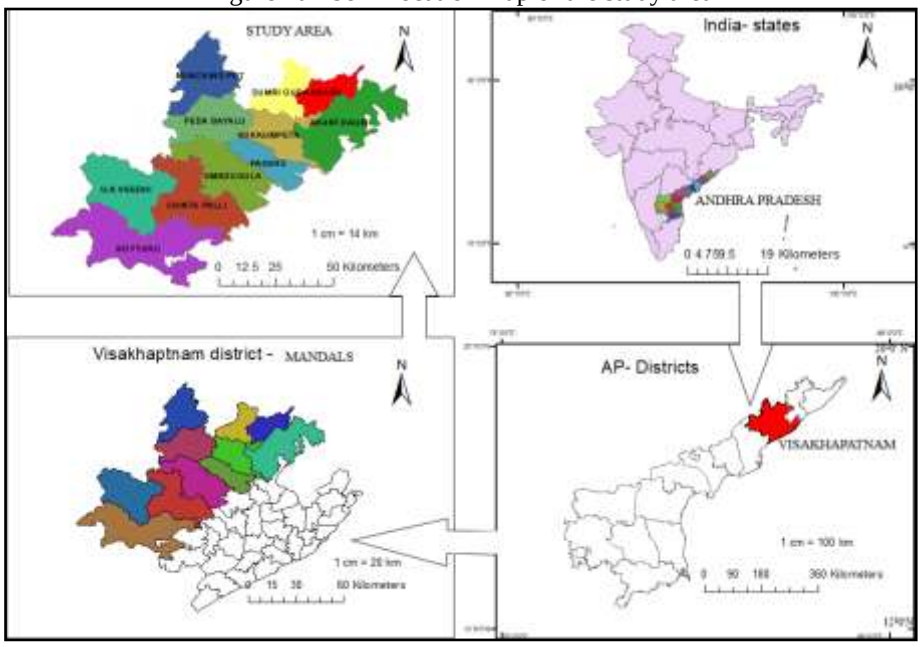
- To study temporal distribution of Malaria disease in the Tribal region.
- To examine the spatial changes of Malaria cases in the Tribal region.
- To observe the decadal Changes of Malaria disease in the Tribal region

III DATA AND METHODOLOGY:

This study is mainly depended on the secondary data. Malaria cases data was collected for the tribal region (Study area) from the year of 2000 to 2019 from the DM&HO, Visakhapatnam district. For data analysis SPSS 17.1 is used and ArcGIS 10.1 is used for preparing location map and for generating geospatial maps for the study.

IV STUDY AREA:

Figure number 1 location map of the study area



The study area (Fig.no. 1) lies between 17º-34' 11" and 18º-32' 57" Northern latitude and 18º-51' 49" and 83º-16' 9" in Eastern longitude. It is bounded on the North partly by Orissa state and

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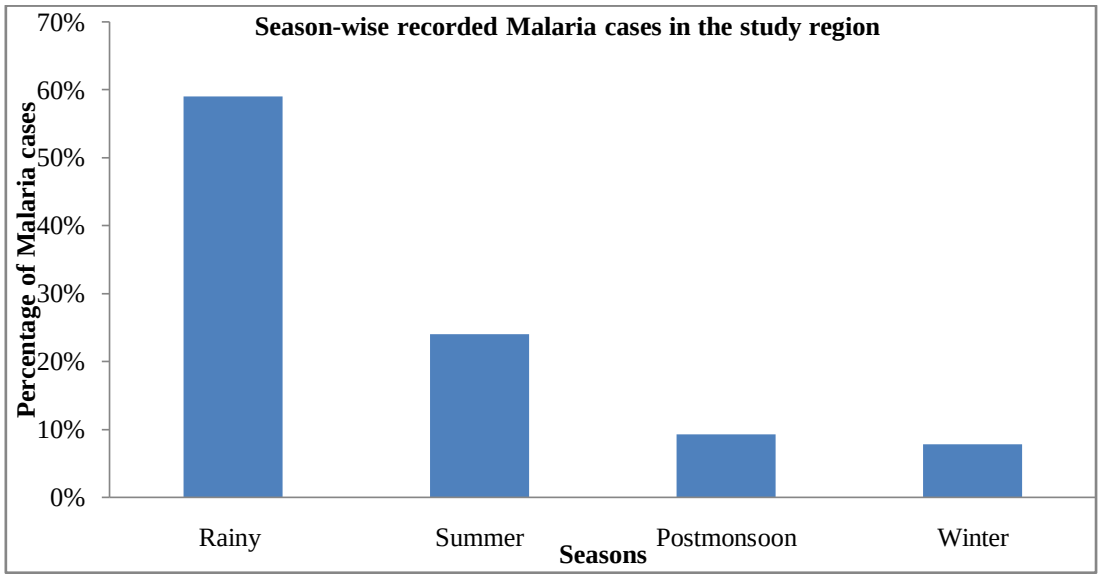
partly by Vizianagaram district, on South by East Godavari district, on West by Orissa state and East by 32 plain mandals Visakhapatnam district. The study area contains 11 administrative mandals. They are 1. Chinthapalli, 2. Koyyuru, 3. G.K.Veedhi, 4. G.Madugula, 5. Paderu, 6. Pedabayalu, 7. Munchingput, 8. Hukumpeta, 9. Dumbriguda, 10. Araku valley and 11. Ananthagiri Mandals. Physiographically this region extends between 300m MSL to 600m and above MSL and also called as agency area. Natural vegetation includes semi evergreen, most deciduous and dry deciduous forests. The total geographica area of the study region is 5,822 Sq.km of which 60 percent is forest land and approximately 20 percent is arable land and the rest is distributed among barren, uncultivable land and fallow land.This region is a catchment area for several rivers like Machkund, Sileru, Sarada, Varaha, Tandava and Goshtani in addition to these, there are several hill streams that water the district (20). The average annual rain fall of the study region is 1300 m.m. The total study region contains about 2425 villages and 3,536 hamlets with a population of 6,04,047 (49% Male population and 51% female population) in which about 90.7% were ST people according to 2011 census. Due to thick forest vegetation, streams and also due to Socio economic condition of the region, in this study it is expected that there would be more Malaria cases in this region. In this background an attempt is made in this paper, to study the spatiotemporal changes of Malaria disease in the study region.

V RESULTS AND DISCUSSION:

MALARIA CASES RECORDED ACCORDING TO SEASONS IN THE STUDY REGION:

figure number 2 percentage of malaria cases according to seasons in the study region during 2000-2019 period.



The total number of Malaria cases recorded during 2000-2019 period in the study region (Eleven Mandals of Tribal region of Visakhapatnam district) were about 1,09,658 in which about 59% cases recorded in Rainy season (Fig.no.2) followed by Summer season (24%), Post monsoon season/ retreating monsoon season (9.2%) and Winter season (7.8%). According to the data, it was observed that, the Rainy season and summer season were contributed for about 83% of total Malaria cases recorded during the study period in the study region.

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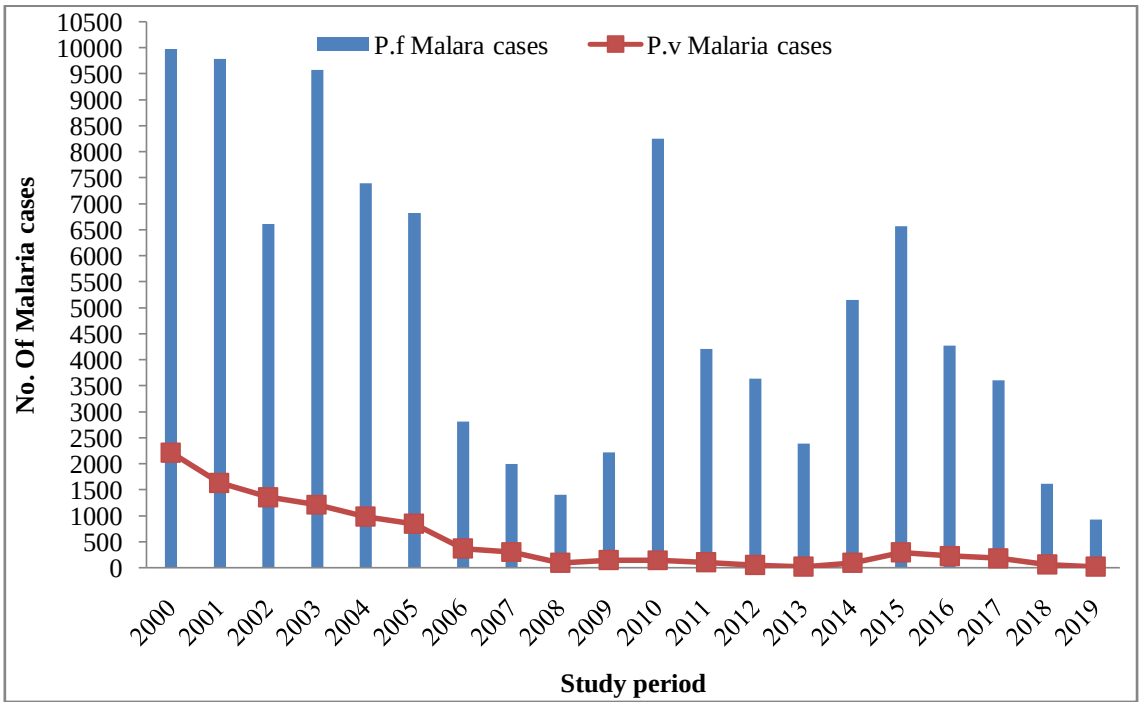
I. TEMPORAL DISTRIBUTION OF MALARIA CASES (P.V TYPE AND P.F TYPE) RECORDED IN
figure number.3 P.v type and P.f type malaria cases recorded in the study area during 2000-2019.



The temporal changes of P.f type and P.v type Malaria cases recorded during 2000-2019 period in the study region shown in Fig .no.1. The total number of Malaria cases recorded in the study region was about 1,09,658 Malaria cases between 2000-2019 period (20 years) in which 90.5 % P.f type Malaria cases and the remaining 9.5 % belongs to P.v type Malaria cases.

Regarding P.f type Malaria cases about 99,298 cases were recorded between 2000 and 2019 (20 years) period. In which about 59% Malaria cases was recorded between 2000 and 2009 (10 years) period. Whereas remaining where as 41% of Malaria cases between 2010-2019 (10 years) period. Out of the total P.f type Malaria cases (58,639) recorded between 2000 and 2009 (10 years) about 74% of Malaria cases were recorded during 2000-2004(5 years) period and the remaining 26% of Malaria cases were recorded between 2005 and 2009 (5 years) period. Out of the total PF type Malaria cases were recorded between 2010 -2019 (40,659) about 58.2% cases recorded during 2010 -2014 (5 years) period. The remaining 41.8% of Malaria cases were recorded between 2015 and 2019 (5 years) period.

Regarding P.v type Malaria cases about10, 387 cases were recorded between 2000 and 2019 (20 years) period. In which about 88% of Malaria cases were recorded between 2000 and 2009 (10 years) period. Whereas remaining 12% Malaria cases recorded between 2010 and 2019 (10 years) period. Out of the total P.v type Malaria cases recorded between 2000 and 2009 (9,022) cases about 82% cases recorded during 2000-2004 (5 years) period and the remaining 18% cases were recorded between 2005-2009 (5 years) period. Out of the total P.v type Malaria cases were recorded between 2010 and 2019 (1365) cases about 35% cases recorded between 2010 and 2014 (5 years) period. And the remaining 65% of the Malaria cases were recorded between 2013 and 2019 (5 years) period.

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II. SPATIAL DISTRIBUTION OF MALARIA CASES IN THE STUDY REGION:
Figure number 4 spatial distribution of total malaria cases in the study region during 2000-2019.

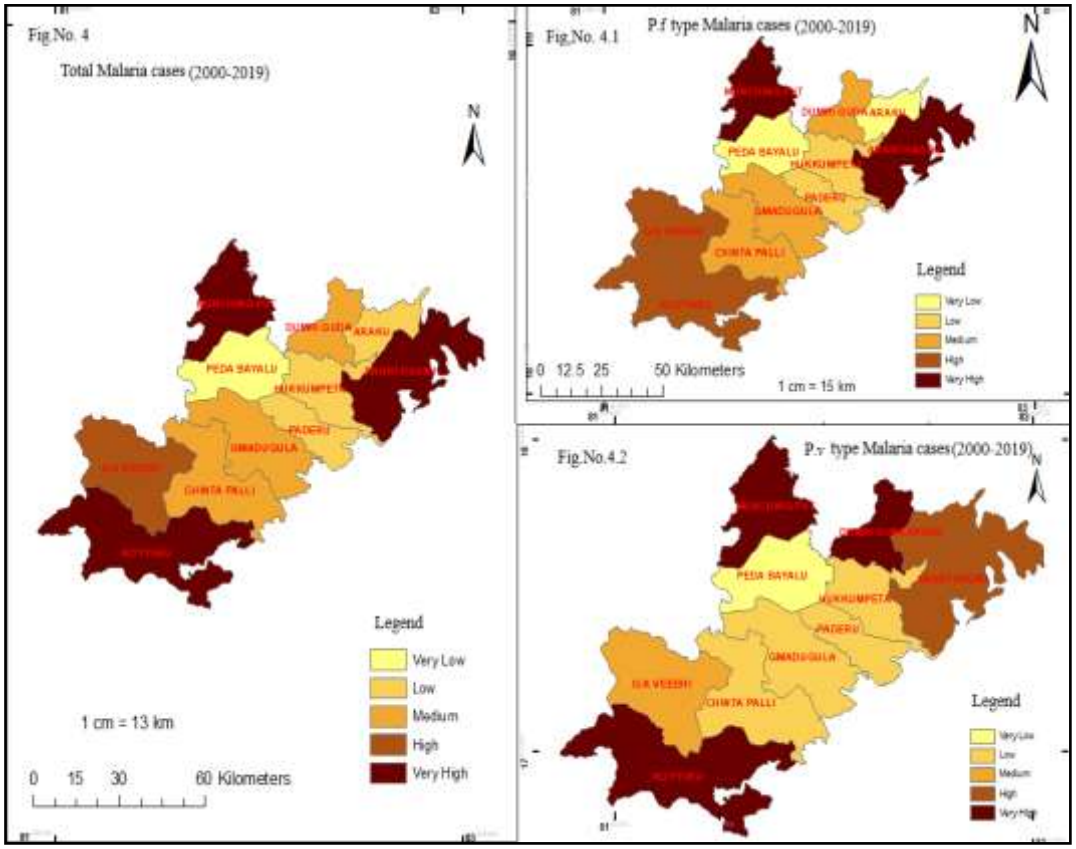

Fig. 4 showing spatial distribution of Malaria cases during 2000-2019 period in the study region. About 1,09,658 Malaria cases were recorded (including P.f type and P.v type Malaria cases) in the study region , in which highest percentage of Malaria cases were recorded in Munchingput (14.8%) followed by Anantagrir (13.8%), Koyyuru (12.5%) and G.K. Veedhi (10.5%) and these 4 Mandals contributed for 51.6% of the total Malaria cases recorded in the study region during the study period. The remaining 48.4% of Malaria cases were recorded in 7 mandals. They were Dumbriguda (9.3%), G. Madugula (9.1%), Chintapalli (8.2%), Paderu (6.6%), Araku (6%), Hukumpeta (5.5%) and Pedabayalu (4.2%).

Regarding P.f type Malaria cases (Fig. no. 4.1) about 99,298 Malaria cases recorded in the study region in which highest percentage of Pf type Malaria cases were recorded in Munchgput (14.2%), followed by Anantagiri(13.7), Koyyuru (11.5%), G.K.Veedhi (10.9%). These 4 Mandals contributed for 50.3% of the total cases of the study region. Further G. Madugula (9.7%), Chintapalli (8.8%), Paderu (7%) were contributed for 25% of the total cases of the study region. Low percentage of Malaria cases were recorded in Hukumpeta (5.9%), Arakuvalley (5.2%) and Pedabayalu (4.5%).

Regarding P.v type Malaria cases (Fig.no. 4.2) about 10,387 P.v type Malaria cases were recorded in the study region in which highest number of cases were recorded in Koyyuru (22.4%) followed by Munchgput (20.5%) and Dumbriguda (22.4%). These three Mandal contributed for about 60.7% of the total cases of the study region. Further Anantagiri (9.7%), Araku (12.3%) and G.K.Veedhi (6.6%) were contributed for about 28.6% of the total cases in the study region. Low and very low case were recorded in other remaining mandals of the study region.

It can be observed from the above discussion that all mandals of the study region recorded Malaria cases throughout the study period and this was because most of the mandals received rainfall between 1200 mm to 1600 mm. per annum and also 60% of the study region under forest (Evergreen, Semi evergreen and degraded forests).

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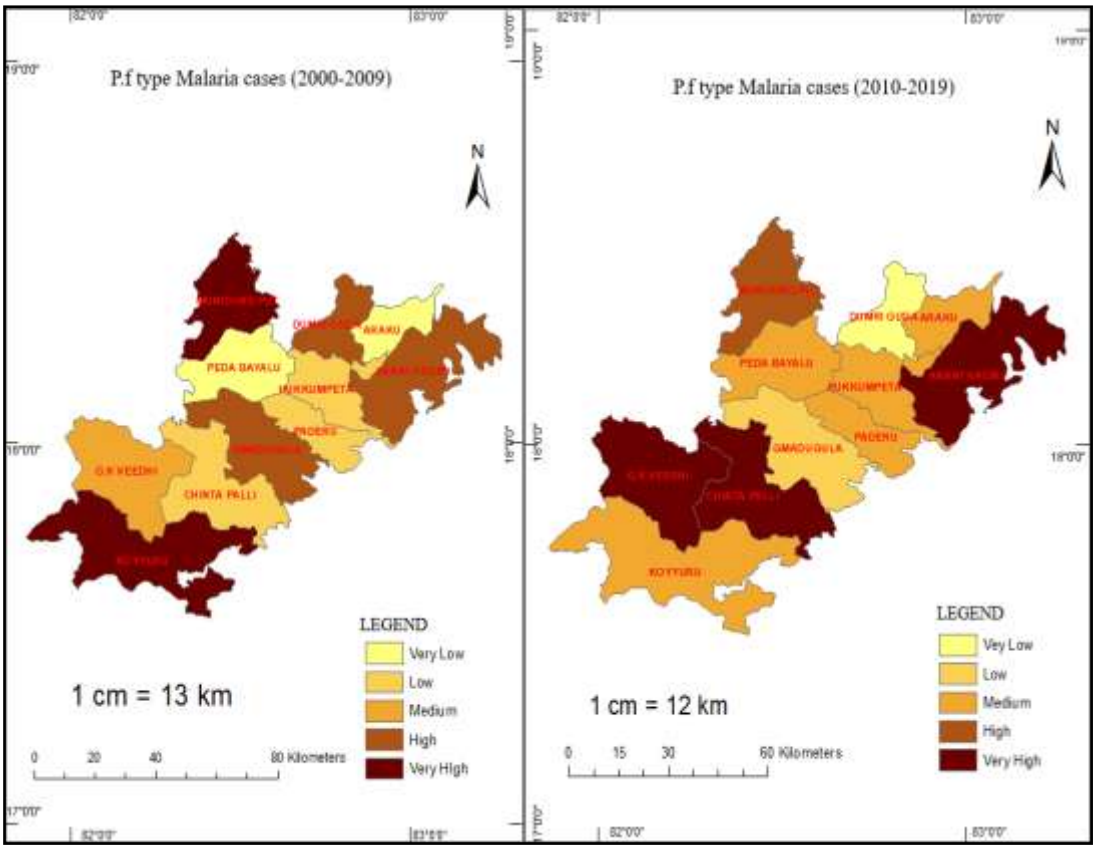
III. DECADAL CHANGES OF MALARIA CASES ACCORDING TO P.f TYPE AND P.v TYPE MALARIA CASES:

(A) DECADAL CHANGE ACCORDING TO P.F TYPE MALARIA CASES.

The study area recorded about 99,298 P.f type Malaria cases were recorded during 2000-2019 period in which about 59% cases were recorded during 2000-2009 period and 41% of cases recorded during 2010-2019 period. The study noticed about 31% of cases reduction in PF type Malaria cases during the studyperiod. During 2000-2009 Very high P.f type cases were recorded in 1). koyyuru, 2). Munchungput Mandals and Highest Malaria cases were in 1).Dumbriguda 2). Ananthagiri 3).G. Madugula, whereas during 2010-2019 period Very high Malaria cases were recorded in 1) G.K Veedhi, 2). Chintapalli and 3).Anantagiri and High Malaria cases were recorded in Munchigput. In the second decade all of the tribal region mandals have shown decreasing trend except Chintapalli, Pedabayalu and Araku.

figure number 5 decadal-wise change in P.f type malaria cases in the study region during 2000-2019.



(B) DECADAL CHANGE IN MALARIA CASES ACCORDING P.V TYPE IN THE STUDY REGION DURING 2000-2019:

The study area recorded about 10,387 P.v type Malaria cases were recorded during 2000-2019 period, in which about 88% cases were recorded during 2000-2009 period and 12% of cases recorded during 2010-2019 period. The study noticed about 77% of cases reduction in P.v type Malaria cases in the study period.During 2000-2009 Very high P.v type cases were recorded in 1). koyyuru, 2).Munchungput 3). Dumbriguda Mandals and Highest Malaria cases were in 1). Araku 2). Ananthagiri 3).G. Madugula whereas during 2010-2019 period Very high Malaria cases were recorded in 1) Anantagir 2). Araku and High P.v type Malaria cases were recorded in 1).Munchigput and 2).G.K. Veedhi and In the second decade all of the tribal region mandals have shown decreasing trend.

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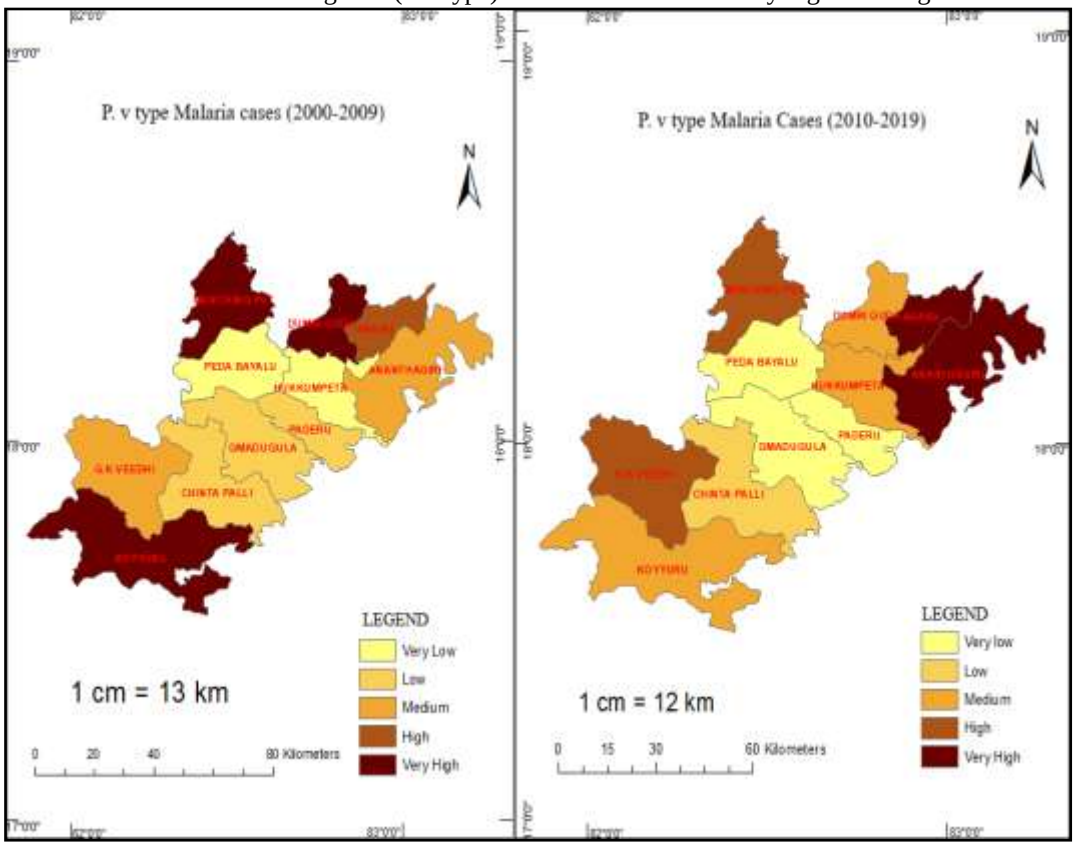
Figure number 6 decadal- wise changes in (P.v type) malaria cases in the study region during 2000-2019.



VI. CONCLUSION:

The study area is a hilly region with 60% of it's geographical area occupied by different types of forests and it also receives 1300 mm rainfall annually. Among the total population about 96% of population belong to S.T (scheduled Tribes) categories that were socially and economically backward. The study region recorded on an average about 5,489 Malaria cases per year in the study region. In this context this region become one of the high rate Malaria prevalent regions of India and most recorded Malaria parasite in this region was Plasmodium falsiparum. Most of the Malaria cases were recorded during the Rainy season and Summer season and the highest Malaria cases were recorded in Munchugput, Anantagiri, Koyyuru and G.K Veedhi mandals. To eradicate and to reduce Malaria menace, a comprehensive plan must be prepared by the local Medical & Health Department, village panchayat's, MRO's and MDO's to see the healthy ST people in the study region.

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