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Geospatial Analysis of High-Risk Malaria Region. In the Case of Dembia Woreda, Northern, Ethiopia.

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1. Background of the study

Malaria is a global public health problem that causes excessive morbidity and mortality and is a major burden of confusion (WHO, 2014). In 2019, an estimated 229 million malaria outbreaks worldwide occurred, 94% of which occurred in the WHO region of Africa (WHO, 2020).

There is no robust forecasting or early warning methods that enable estimation on the likely burden of malaria to ensure preparedness. As a result, epidemics capture health facilities and communities almost unnoticed until the capacity of health facilities is overwhelmed. In view of such adverse impacts, at least, the existing surveillance system aimed at early detection, verification, notification and containment of an epidemic within two weeks of its onset needs to be strengthened (MOH, 2006). In any disease control program, there are several factors involved, namely estimation of disease burden, monitoring of disease trend, identification of risk factors, planning, allocation of resources, implementation, etc. (Connor S.J et al, 1997).

Ethiopia is one of Africa's most endemic malaria burdens, with more than 48 million threats and 4.5 million scientific incidents occurring each year (Connor et al., 2008). The disease has immeasurable negative effects on the social existence and economic well-being of society. The types and depths of transmission vary significantly due to the very large altitude, temperature, precipitation, and migration bandwidth (Ghebreyesus, et al., 2006). Depending on the location, malaria transmission can be perennial and endemic (contagion period 7-12 months), seasonal and endemic (4-6 months), or highly seasonal or endemic (1-3), (MOH, 2004 and WHO, 2001). In addition to seasonal variation, there may be year-to-year fluctuations in the number of malaria cases (MOH, 2003). Although the prevalence of malaria has dropped dramatically due to major management programs (MOH, 2008), malaria is still one of the largest public fitness problems in the Country.

In Amharic National Region State (ANRS), more than 75% of the population is at risk. Malaria affects more than 80% of the Region.5-1.2 million clinical cases are reported each year, with 30-50% of outpatient visits, 15-40% of total inpatients and 7-30% of total inpatient deaths associated with malaria (ANRSHOB, 2009). Dembia is one of the districts listed as malarious

area. Between 2000 and 2007, an average of over 121,000 malaria cases were registered annually (Seid, 2007). This means that near to half of the Woreda population has been at risk. Historical evidence of malaria outbreaks in the Districts of Ethiop is found in the report of Covell (1957), which reported an estimated 7,000 deaths in the 1953 plains of Malaria due to a malaria epidemic. According to Collins et al. (1971) has such high levels due to the short transmission season (usually limited to October and November), which reduces the level of functional immunity of the local population. Effective preventive measures need to be planned to mitigate the human tragedy that is occurring in the Dembia Plains due to the malaria epidemic. No matter what plans were made in the area, they were not supported by accurate and reliable spatial and temporal databases that could be updated on a regular basis. This research fill-in this major gap using Geographic Information System (GIS), Remote Sensing (RS), and Global Position System (GPS) are state-of-the-art tools used in identifying, classifying and mapping vulnerability to a problem that has spatial dimension.

2. Method

2.1. Study Area

Dembia Woreda is located Northern Ethiopia between latitude N12˚11’30”, N12˚37’07” and longitude E37˚02’59”, E37˚29’13” at degree, minute, second. It has an average elevation of 2000 m above sea level, and covers a total area of 1,057.3 square kilometers.

The coordinates of the health Centers and ground truth points in Dembia Woreda were acquired on the field using a Global positioning system (GPS) unit, as well as questionnaire administration from 15- to 27, December 2020. As a secondary data, articles, Journals, pertinent literatures, the internet, Street guide maps, Digital elevation Models, Landsat imaging data, administrative maps, river maps, and water bodies were all used as secondary data for this study. For land use and land cover, category approximately 48 GPS training sites have been accrued withinside the decided on six kebeles. The kebeles were Darna, Wawa, Girarge, Senbetdeber, Adsige-Dinge, and Mange.

The breeding sites of mosquitoes within 2kms distance to the villages were selected by using purposive sampling technique because the breeding sites are aquatic bodies and these are found in only three areas in the time of data collection. The reason for the selection is because the flying range of the vector is two kilometers (Connor S.J et al, 1997). The entomological surveys comprised the collection of larval mosquitoes. Surveys were conducted two times in the five study villages. Larval surveys were carried out in water bodies within a radius of 2 km of each village. In each survey, all types of available potential mosquito breeding habitats were inspected for the presence of mosquito larvae. Potential mosquito breeding habitats in the study

area included holes; agricultural field puddles and Lake Tana but not rain puddles because the survey of data collection was done between January 20 to February 5, 2020. In this season, there is little or no rainfall. Rainwater harvesting was not practiced in any of the villages. Hence, those kebeles that are closer to Lake Tana, perennial rivers, spring and man-made pools were selected for the survey

In Decision theory, multi-Criteria Evaluation is the process of applying a decision rule to a set of alternatives. A decision rule is a procedure by which criteria are combined to arrive at a particular evaluation, and by which evaluations are compared and acted upon.. Factors are generally continuous in nature, such as slope gradient or road proximity. They indicate the relative suitability of certain areas. Constraints, on the other hand, are always Boolean in character such as the reserved lands constraint. Weight is used to develop a set of relative weights for a group of factors in a multi-criteria evaluation. The weights are developed by providing a series of pair-wise comparisons of the relative importance of factors to the suitability of pixels for the activity being evaluated

Conceptual Framework of the study

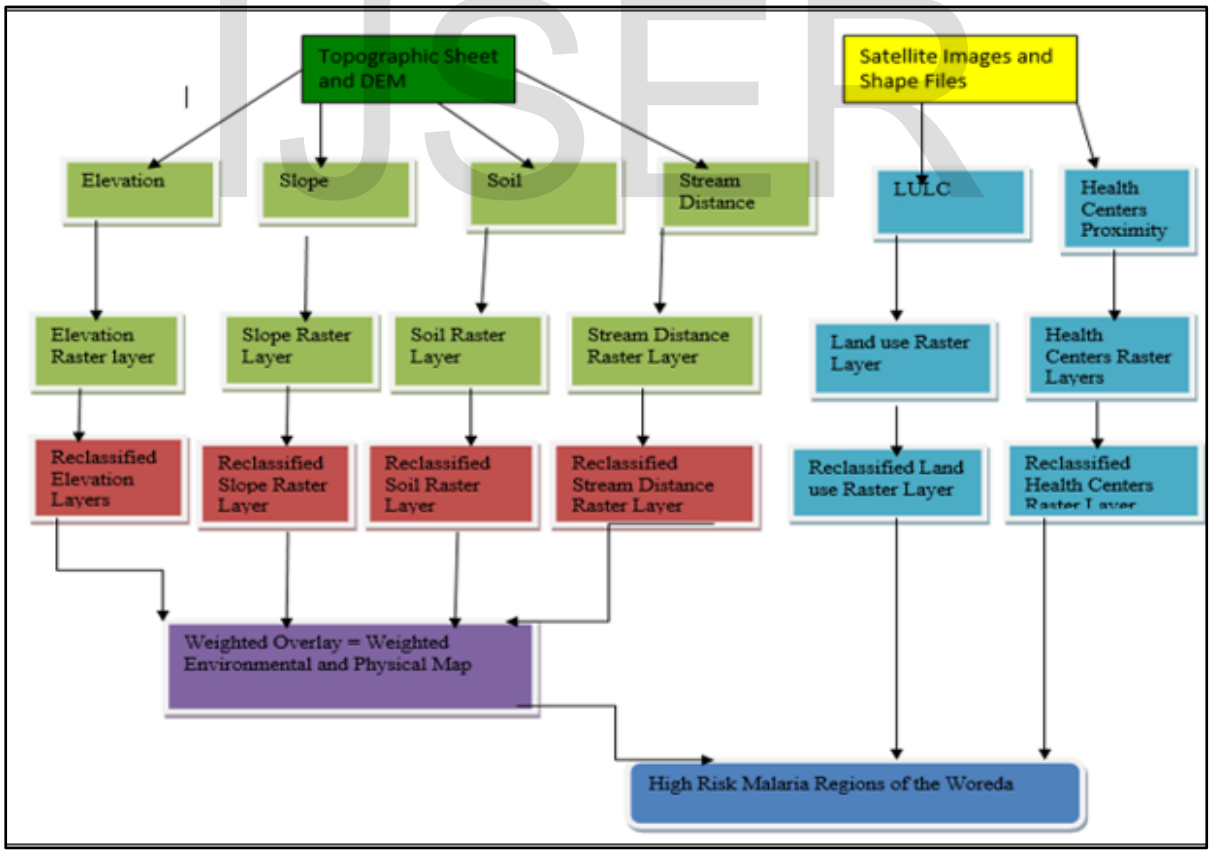

Fig 1. Conceptual framework of the study.

The breeding sites of infected mosquitoes vary greatly with regards to species. Many of these

sites develop into zones of transmission due to the concomitant increase of human populations moving to these areas. The number of possible breeding sites is extensive, and describing a few more of them will help to illustrate the difficulty in finding a common solution to control of malaria transmission by limiting mosquito populations. Ecological disturbance as a direct result of human activity may also increase the number of breeding sites. Road building and maintenance projects often impede drainage of runoff from rainfall. Clogged drainage ditches along roads left by logging and construction activities are ideal places for floodwater mosquitoes.

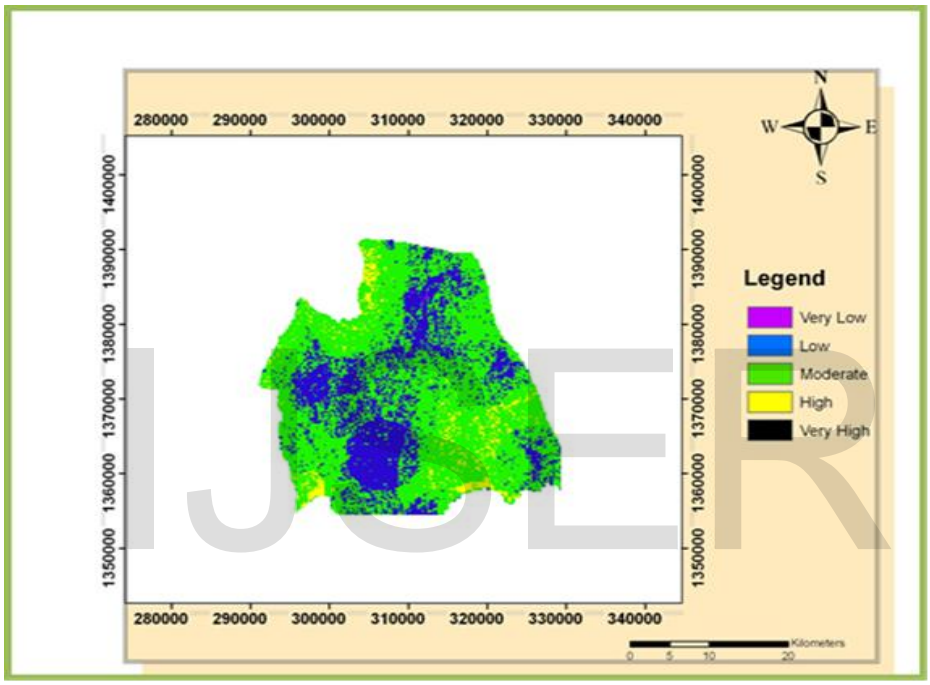

Fig 3.2. Reclassified Malaria Risk Area Layer

It is estimated that 23.64 km2, 481.16 km2, 463.44 km2, 88.76 km2, and 0.6 km2 areas of Dembia Woreda are subjected to very high, high, moderate, low, and very low malaria risk. (See Fig 1.2). The analyzed output map showed the high-risk malaria regions were being identified and mapped

The study has attempted to develop a malaria risk map that could support decision-making process in the Dembia Woreda malaria control programs. In addition to these malaria risk map, identification of high-risk malaria regions and generation of information are a good approach to deduce a sound decision for a forthcoming malaria disaster, provided the required data are standardized to a common scale in personal geodatabase. This research confirmed the method used was capable of integrating all the malaria risk causative factors and the components of malaria risk in a GIS environment.

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