

FDRE
Ministry of Water and Energy
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Bio Meteorology and Insurance Index Desk



Climate Information
For
The Health Sector

December_2022

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Foreword

This "Climate Information for the Health Sector" Bulletin has been designed to convey essential information regarding the monitoring of human comfort conditions based on the analysis of temperature and humidity data and also for the monitoring of Malaria outbreak areas based on the analysis of temperature and precipitation data.

Since the monitoring of temperature and rainfall over a given area can be used to assess the likelihood of outbreak of Malaria with a lag of two months, this information can be an important for early warning tool if used judiciously.

The major objective of this bulletin is in line with the Ethiopia Meteorological Institute strategy of diversifying climate application products to the basic developmental sectors (such as the Health, the water, the agricultural sector etc...). This bulletin can be a very important source of information to Health professionals engaged in the monitoring of Public Health, to Tourism Agents and institutions who advise tourists regarding the comfort conditions of the places to be visited by the tourists and to the researcher who is interested in the field of Bio-Climatology.

We have the opinion that careful and continuous use of this bulletin can benefit to the improvement of early warning and preparedness in the Health sector.

Meanwhile, your comments and constructive suggestions are highly appreciated to make the objective of this bulletin a success,

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INTRODUCTION

- Biometeorology Case Team has the Responsibility to work on Climate Sensitive Diseases (CSD). Climate Sensitive Diseases are the major diseases that are most sensitive to Weather and climate: **Sensitivity** refers to a test's ability to designate an individual with **disease** as positive. The health **effects** of these disruptions include increased respiratory and cardiovascular **disease**, injuries and premature deaths related to extreme weather events, changes in the prevalence and geographical distribution of food- and water-borne illnesses and other infectious **diseases**, and threats to mental health. CSD can be either;
- i.** Vector Borne Disease like Malaria, Dengue fever and Rift Valley fever;
 - ii.** Water and Food Borne; like Cholera and Diarrhea
 - iii.** Air Borne; like Meningitis, Respiratory syncytial virus (colds) and Influenza. For the three CSD; Temperature, Rainfall, Humidity and Wind are the key parameters for suitability and transmission method. Malaria is the current Public Health threat in Ethiopia. The outbreak level depends on the three major climatic conditions.
- i. Rainfall** ($\geq 80\text{mm}$) is largely responsible for creating the conditions which allow sufficient surface water for mosquito breeding sites and is, therefore, recognized as one of the major factors influencing malaria transmission.
 - ii. Temperature** ($18 \leq T \leq 32$ °C) also plays an important role in the variability of malaria transmission by regulating the development rate of mosquito larvae and influencing the survival rate of adult mosquitoes. Mosquitoes generally develop faster and feed earlier in their life cycle and at a higher frequency in warmer conditions. In addition, the Plasmodium parasite multiplies more rapidly in the mosquito in higher temperatures.
 - iii. Humidity** ($\geq 60\%$) impacts the survival rate of the mosquito as well. Mosquitoes will generally not live long enough to complete their transmission cycle where and when the relative humidity is consistently less than 60%.
In endemic regions these three variables usually create conditions suitable for malaria transmission every year. In the epidemic prone regions one of these variables is typically not sufficient to support transmission.

The second Responsibility of Biometeorology is the Comfortability Index for Human and Animals.

The human response to heat stress can be hyperthermia, heat stroke and other harmful effects. Heat illness can relate to many of the organs and systems including: brain, heart, kidneys, liver, etc. Heat waves have also resulted in epidemics of chronic kidney disease (CKD).

Temperature Humidity Index (THI) is a measure that has been used since the early 1990s. It accounts for the combined effects of **environmental temperature and relative humidity** and is a useful and easy way to assess the risk of **heat stress**. Heat stress is caused by a combination of temperature, relative humidity, solar radiation, air movement, and precipitation. The majority of studies on heat stress in livestock focus on the two main environmental stressors: temperature and relative humidity (RH).

$$\text{THI} = 0.8 * T + \text{RH} * T / 500 \quad \text{for Human}$$

$$\text{THI} = 0.8 * T + \text{RH} * (T - 14.4) + 46.4 \quad \text{for Cattle or Animal}$$

1. RTH Conditions for Malaria Pron area during December 2022.

According to the Ethiopia Meteorological data of December 2022 report; total amount of monthly rainfall 80 mm and above was recorded over ; southern parts of Jimma and Illubabor,Sheka,Keffa, Bench maji, and South Omo zones (Fig 1a). And also monthly mean relative humidity 60% and above were recorded over; Illubabor, Gambela(zone 1 and Godera), Bench maji, South Omo, and sheka zones the country (Fig 1b). And also the monthly mean Temperature between 18°c and 32°c was recorded over in most parts of the country **except** the Highlands of Norther, Central, Souther, Eastern and Western parts of the country and those area shaded in deep **Blue** color (Fig 1c).

As per Grover-Kopek et al. 2006, the favorable climatic conditions for transmission of malaria are; when the monthly precipitation accumulation is at least 80 mm, the monthly mean temperature is between 18°C and 32°C and the monthly mean relative humidity is at least 60%. Accordingly the same method was applied on Temperature, Rainfall and Humidity using meteorological data of December 2022 collected from representative meteorological stations of Ethiopia in order to demarcate all the possible malaria expected areas of the country (fig. 3).

On the basis of the above principle, assessments of December 2022 rainfall, temperature and humidity with respect to the distribution of malaria; *Therefore climatic conditions were favorable for the breeding, survival and distribution of malaria over: Southern Illubabor, Sheka, Bench maji, and South Omo zones of the country during December 2022 (fig.3).*

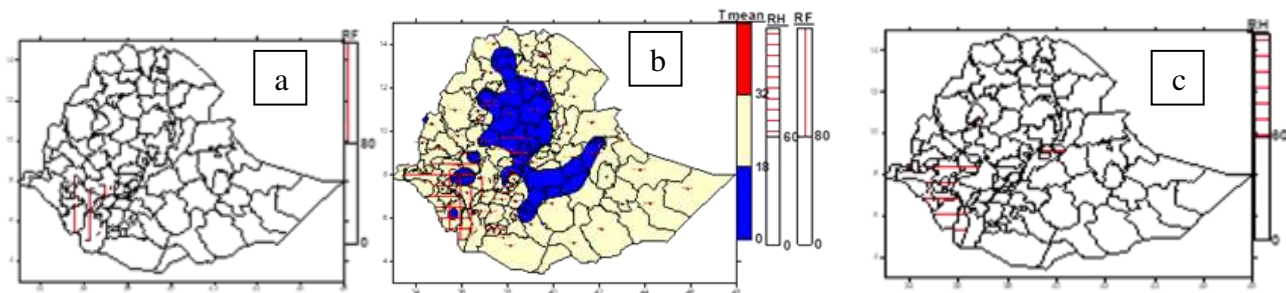


Fig 1:- (a) Monthly total rainfall amount of December 2022 in mm.

Fig 1:- (b) Monthly average temperature in degree centigrade of December 2022.

Fig 1:- (c) Monthly average relative humidity in % of December 2022.

1.1 Average temperatures for the month of December 2022.

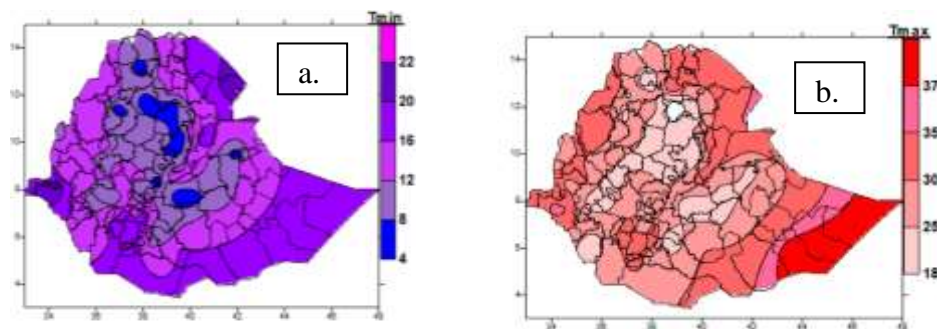


Fig 2 (a). Mean minimum temperature in degree Celsius during December 2022.

Fig 2 (b). Mean maximum Temperature in degree Celsius for the month of December 2022.

1.2 Malaria prone areas during the month of December 2022.

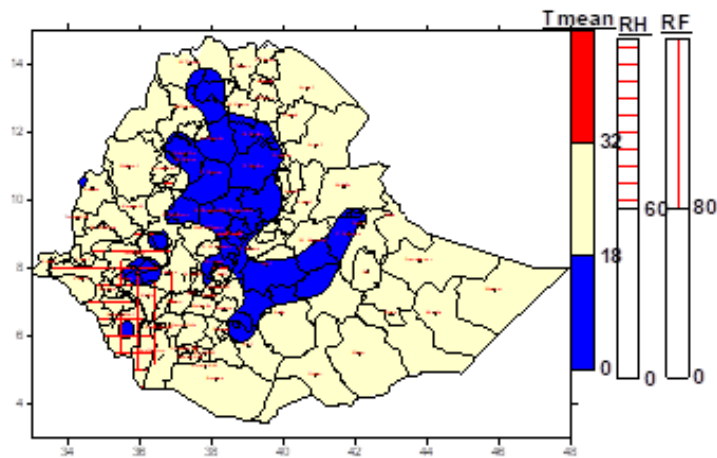


Fig 3:- Combined temperature, rainfall and relative humidity analysis for December 2022.

The above combined map was proposed to show the effect of monthly temperature, rainfall and relative humidity with respect to the survivable and distribution of malaria during the month of December 2022. Regarding to this issue; Areas under squared patterns with light yellowish background colors are assumed to satisfy suitable climatological condition for the existence and distribution of malaria whereas areas whose monthly average temperature below 18⁰C and lowland areas whose monthly average temperature greater than 32⁰C are marked in deep blue and red color respectively and those portion of the country were not favorable for the distribution of malaria.

According to the above principle; areas whose average temperature between 18 and 32 degree Celsius, total rainfall 80 mm and above together with a monthly average relative humidity of 60% and above were observed over the country; ***Therefore climatic conditions were favorable for the survival and distribution of malaria over; Western Oromia, and Southwestern SNNPR regions during December 2022 (fig. 3).***

In general, the rainfall, temperature and humidity ‘RTH’ values with respect to survivable and distribution malaria; if the current monthly assessment of temperature, rainfall and humidity satisfy the above conditions, the climate condition over that specific area automatically considered as favorable for the survival and distribution of malaria and that portion of the country will be marked in light yellowish background color superimposed with squared pattern. The assumption is that these climate variables have *a one to two months* postponed (delayed) effect on the spread of malaria.

2. THI Conditions during December 2022 for Human

With respect to Temperature-Humidity Index (THI), the climatic condition for human being was developed by the US weather Bureau in 1959; it is applied to the temperature and humidity datum over representative stations of the country in order to review the weather condition which was cold stress comfort, moderate and heat stress over all areas covered by indicated climate data sources during the month of December 2022. According to this approach, if the ‘THI’ values exceed 26 almost all the population feel heat stress, if the ‘‘THI’’ values between 21 to 26 half of the population feel uncomfortable (here we refer to it as "moderate") and if the THI values are between 14 than 21 almost all the population feel comfortable (here we refer to it as "comfortable") and if the THI values below 14 almost all the population feels cold stress.

Based on this, the map below shows the Comfortability Index of Human being during the month of December 2022 over the country.

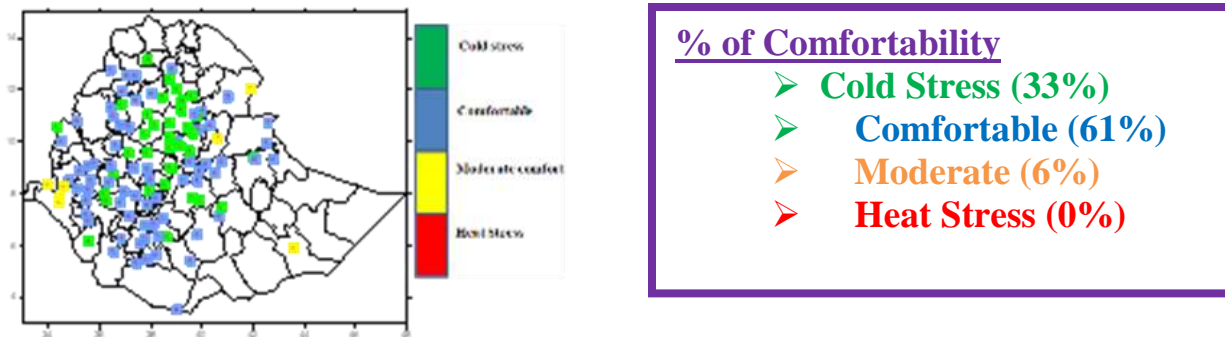


Fig 4:- THI values for Human being during the month of December 2022.

NB. During December 2022, the THI for Human was dominated by Comfortable. But cold stress conditions were observed in the highlands of Northern, Central, Eastern, Western and Southern parts of Ethiopia. The rest parts of the country were in moderately comfortable conditions. No heat stress were observed.

3. THI Conditions during December 2022 for Cattle.

With respect to Temperature-Humidity Index (THI), the climatic condition for Cattle; Taken from studies from the Australia Dairy Association (ADA). Temperature Humidity Index (THI) is a measure that accounts for the combined effects of environmental temperature and relative humidity on cattle / livestock to assess the risk of heat stress and prevent major effects.

Heat stress can have major detrimental effects on animal health and productivity and poses particular challenges to herds in ‘hot’ regions. As well as temperature, relative humidity has a significant effect on heat stress, with the temperature-humidity index (THI) often used to indicate the degree of stress on dairy cattle

When **THI exceeds 72**, cows are likely to begin experiencing heat stress and their in calf rates **will be affected**.

When **THI exceeds 78**, cow’s milk production is **seriously affected**.

When **THI rises above 82**, very significant losses in milk production are likely, cows show signs of severe stress and may **ultimately die**.

Not Stressed (<68)	Stressed threshold (68 to 71)
Mild (72 to 79 THI)	Moderate (80 to 89 THI)
Severe (90 to 99)	Dead Cows (>100)

Based on these Criteria, Monthly THI assessment for Cattle shows below during the month of December 2022 over the country.

December 2022 THI for Cattle

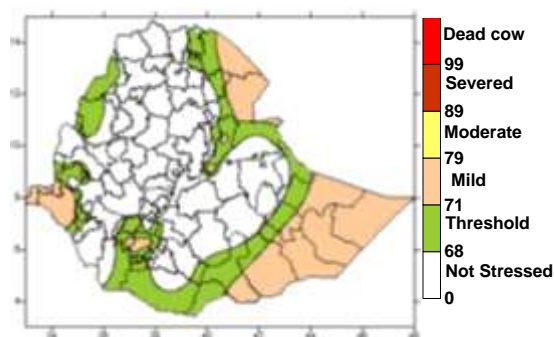


Fig 5:- THI values for Cattle’s during the month of December 2022.

NB. During December 2022, the THI for cattle was dominated by not stressed to mild stress.