



Investigation of the degree of human thermal discomfort using empirical analysis of weather parameters in Guwahati, Assam

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सार – वर्तमान अध्ययन में आर्द्र उपोष्णकटिबंधीय जलवायु वाले असम के गुवाहाटी में प्रमुख मौसम संबंधी मापदंडों का विश्लेषण करके “तापीय असहजता” (Thermal Discomfort–TD) की मात्रा का अध्ययन किया गया है। कृषि गतिविधियों के अनुकूलन और मानव कल्याण में सुधार के लिए महत्वपूर्ण इन मापदंडों की तुलना 1991-2020 तथा 2022-2024 की अवधियों के दौरान विभिन्न जलवायवीय आरेखों, जैसे टेलर क्लाइमोग्राफ (Taylor's Climograph) और हाइथरग्राफ (Hythergraph) के माध्यम से की गई, ताकि इन मापदंडों के प्रभावों और तापीय असुविधा को समझा जा सके। टेलर क्लाइमोग्राफ में मासिक आर्द्र बल्ब तापमान (Wet Bulb Temperature–WBT) और सापेक्ष आर्द्रता (Relative Humidity–RH) को 12-पक्षीय बहुभुज के माध्यम से प्रदर्शित कर जलवायवीय प्रतिरूपों और उनसे संबंधित असुविधा के स्तरों का अध्ययन किया गया। इसी प्रकार, उक्त अवधियों के दौरान वर्षा-तापमान संबंध को समझने के लिए हाइथरग्राफ का भी उपयोग किया गया। इसके अतिरिक्त, वायु तापमान और सापेक्ष आर्द्रता को सम्मिलित करके अनुभूत तापमान (“फील्स-लाइक” परिस्थितियों) का आकलन करने वाले ताप सूचकांक (Heat Index–HI) को तापीय प्रतिकूलता के व्यापक मूल्यांकन के लिए उपयोग किया गया। जून, जुलाई, अगस्त और सितंबर में तापीय प्रतिकूलता की सर्वाधिक मात्रा-गर्म एवं आर्द्र, अर्थात् टेलर के अनुसार “उमसपूर्ण”-पाई गई तथा 2022-2024 में 1991-2020 की तुलना में अधिक चरम तापमान दर्ज किए गए। HI विश्लेषण से पता चला कि मई से अक्टूबर तक अधिकतम तापमान (Tmax) 40°C से अधिक रहा तथा 2022-24 के दौरान सितंबर में अनुभूत तापमान 55.5°C के उच्चतम स्तर तक पहुँचा, जिसे “अत्यधिक खतरा” श्रेणी में रखा गया, जिसमें लू लगने की अत्यधिक संभावना होती है। वर्तमान आकलन में मानसून-पूर्व (मई), मानसून (जून-सितंबर) तथा मानसूनोत्तर (अक्टूबर) अवधि के दौरान गर्म एवं आर्द्र परिस्थितियों को देखते हुए कृषि क्षेत्रों में मृदा की इष्टतम नमी एवं पोषक तत्वों के स्तर को बनाए रखने के लिए निगरानी आवश्यक है। मानव स्वास्थ्य की दृष्टि से अध्ययन में पर्याप्त जल ग्रहण करने तथा सीधे सूर्यप्रकाश के संपर्क को न्यूनतम रखने के महत्व पर बल दिया गया है। क्लाइमोग्राफ, हाइथरग्राफ और HI आँकड़ों को एकीकृत करके इस अध्ययन में तापीय प्रतिकूलता की महत्वपूर्ण अवधियों की पहचान की गई तथा जलवायु परिवर्तन की पृष्ठभूमि में गुवाहाटी जैसे क्षेत्रों के लिए कृषि एवं सार्वजनिक स्वास्थ्य संबंधी अनुकूलन रणनीतियाँ प्रस्तुत की गई हैं।

ABSTRACT. The present investigation deals with the degree of “Thermal Discomfort” (TD) by analyzing key weather parameters in Guwahati, Assam, known for its humid subtropical climate. These weather parameters have been compared during 1991 to 2020 and 2022 to 2024 through various climatic diagrams like Taylor's Climograph, Hythergraph, and other similar diagrams to understand the impacts of these parameters on TD, crucial for optimizing agricultural practices and improving human wellbeing. Taylor's Climograph, employing a 12-sided polygon to graphically represent monthly Wet Bulb Temperature (WBT) and Relative Humidity (RH), was used in this study to

provide insights into climatic patterns and associated discomfort levels. Similarly, “Hythergraph” was also incorporated to understand the rainfall-temperature relationship during these periods. Additionally, Heat Index (HI), a metric combining air temperature and RH to estimate perceived temperature (“feels-like” conditions), offered a comprehensive assessment of thermal stress for this study. The highest “degree of discomfortability” (hot and humid; “muggy” after Taylor) was found in June, July, August, and September, with more extreme temperatures during 2022-2024 compared to 1991-2020. HI analysis showed that the maximum temperature (Tmax) exceeded 40°C from May to October, with the highest perceived temperature peaking at 55.5°C in September during 2022-24, which was classified as “Extreme Danger,” where heat stroke is highly likely. Considering the hot and humid conditions during the pre-monsoon (May), monsoon (June-September), and post-monsoon (October) as reflected from the present assessment, it is crucial to monitor agricultural fields to maintain optimal soil moisture and nutrient levels. For human health, this study emphasized the importance of staying hydrated and minimizing exposure to direct sunlight. By integrating Climograph, Hythergraph, and HI data, this research identified critical periods of TD. It provided adaptive strategies for agriculture and public health, aiding informed decision-making in regions like Guwahati amidst climate change.

Key words – Wet bulb temperature, Relative humidity, Climograph, Hythergraph, Heat index, Thermal discomfort, Guwahati.

1. Introduction

Climate is crucial in determining human comfort and wellbeing, particularly in regions with diverse meteorological conditions like Guwahati, Assam. The degree of “uncomfortability”, a measure of how weather conditions affect human perception and physiological stress, is influenced by various meteorological parameters, including temperature and humidity (Venkiteswaran & Swaminathan, 1967; Gagge & Gonzalez, 1974; Li *et al.*, 2021; Emetere, 2022; Chow, 2024, and references therein). Climatic diagrams, which provide a graphical representation of these parameters over time across various geographical regions, are treated as an essential tool for understanding the variations and trends of weather-induced discomfort (Maity, 2021). Recent studies (*e.g.*, Pogačar, 2017; Somanathan *et al.*, 2021, and references therein) reported that warmer years are associated with lower economic outputs in the case of developing countries. It was estimated that the workers’ productivity was reduced during the hot days, while absenteeism increased in the case of India (Jagatheesan *et al.*, 2004; Somanathan *et al.*, 2021). Further, Shukla and Attada (2023) revealed a notable increase in intense thermal heat stress most frequently during the summer season in India, especially in northwest India, based on the assessment of the CMIP6 models. Therefore, it is required to mitigate the adverse effects on human wellbeing by implementing an early warning system, which is further associated with agricultural productivity. Pai *et al.* (2013) analysed the long-term climatological trends of the heat waves across various stations in India. They found very rare waves in the northeast region, while the north, northwest, central and northeast peninsular experienced more than eight heatwave days per hot weather season, ranging from March to July. Moreover, a recent study conducted by Desai *et al.* (2021) indicated that heat stress increased during the summer months from 1969 to 2015, while the TD condition was aggravated during the end months of the monsoon season. Rajeevan *et al.* (2023) reported that the trends of heat wave duration and

frequency both increased in Guwahati during March to June from 1961 to 2020. The study conducted by Pogačar (2017) found that climate change and associated high-frequency heat waves had significant impacts on the wellbeing and productivity of the farmers in Slovenia. Most of the surveyed farmers reported that excessive sweating and tiredness were the most common symptoms resulting from the heat stress, which reduced their working capacity significantly.

Guwahati in Assam, situated in the northeastern region of India, experiences a subtropical humid climate with distinct seasonal variations. The city encounters high temperatures and humidity during the pre-monsoon and monsoon months, leading to significant TD among residents (Government of Assam, 2025a). Conversely, the winter season is characterized by relatively lower temperatures and moderate humidity levels, resulting in more favourable living conditions (Government of Assam, 2025b; 2025c). A recent study conducted by Das *et al.* (2020) reported a steady increase in mean maximum temperature (Tmax) and mean minimum temperature (Tmin) over time, from 1981 to 2018, in Guwahati. It was evident that the mean daytime temperature of Guwahati has increased in the post-monsoon period, while nighttime temperatures also increased during the monsoon months. They further revealed that the increasing trend of Tmax was observed during the monsoon season except for June. Understanding the fluctuations in discomfort levels across different seasons is essential for urban planners, health officials, and agricultural practitioners, as weather-induced heat stress affects public health, labour productivity, and agrarian operations (Zhao *et al.*, 2017; Flouris *et al.*, 2018). Bhuiyan *et al.* (2017) reported a comprehensive assessment on the impact of thermal stress on the vegetation health as well as agricultural drought in Gujarat during 1981 to 2010. They found a strong correlation between above-ground air temperatures and vegetation health index, hence indicates a definite influence of thermal stress on the vegetation health. Recently, De Natale (2023) also analysed the impacts of

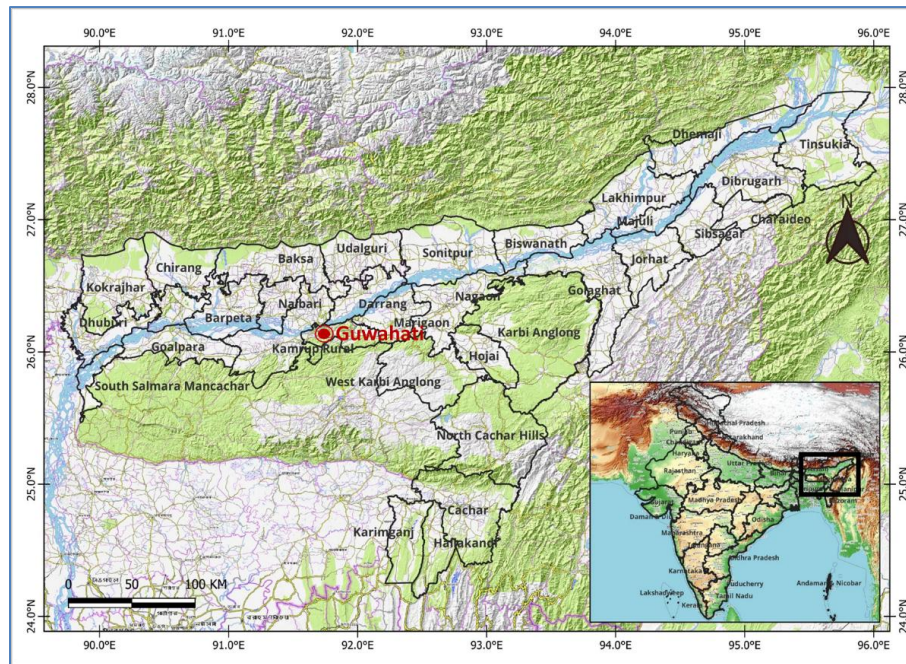


Fig. 1. Location of Guwahati in the northeastern state of Assam

drought and heat indices on the agricultural productivity, where rice, wheat and maize were the three major crops concerning drought and heat indices. Dong *et al.* (2024) studied that heat-related stress was a significant constraint for maize productivity under high temperature, RH and vapour pressure. Khayat *et al.* (2022) reviewed the climate change-induced heat stress on the farmworkers' health. They identified various factors, e.g., kidney disease and heat-related illness, including female gender, dehydration, heat strain, wearing inappropriate clothing, workload, piece-rate payment, job decision latitude and hot environmental conditions, which are unique to the vulnerable agricultural labourers. Therefore, it is evident that climatic discomfort in agrometeorology affects agricultural labourers and farm productivity, as prolonged exposure to extreme weather conditions can reduce work efficiency and increase the risk of heat-related illnesses.

The study conducted by Zhao *et al.* (2017) reported that an increase in temperature decreased the yield of major crops, e.g., wheat, rice, maize, and soybean, etc. Further, it was estimated that an increase of each degree Celsius of global temperature can reduce the global yields of these four crops by 6%, 3.2%, 7.4% and 3.1% respectively. It was studied that the warm temperature increased the growth of the phenological stages without the effect of vegetative biomass (Hatfield & Prueger, 2015). However, they reported that warmer temperatures reduced the yield of grains such as maize by 80% to 90% due to the water deficits. Sun *et al.* (2019) also revealed that rising air temperature will intensify over time, with

India and Brazil ranked highest in exposure to integrated heat stress by the 21st century. The analysis of climatic diagrams, e.g., Taylor's Climograph and Hythergraph, as well as the analysis of Heat Index (HI), provides valuable insights into how weather extremes can impact not only human comfort but also broader socioeconomic activities, including agriculture and urban development, through the analysis of various weather parameters. Gurram *et al.* (2013) evaluated the impacts of different weather parameters on urban sprawl in Hyderabad, India by assessing the Climograph and Hythergraph. Jagatheesan *et al.* (2004) showed the rainfall-temperature relationship across various Agroclimatic Zones (ACZs) in Tamil Nadu through the representation of a Hythergraph. Forbes (1943) plotted a few Hythergraphs from South Africa to show and compare the climates across cities. Similarly, Inoue (2017) investigated the climatic conditions in various locations of Japan using monthly mean temperature and monthly cumulative rainfall provided by the Japan Meteorological Agency during 1981 to 2010, which were used for the crop adaptation test. It is therefore reported that no such studies were found in the case of the northeastern states of India, where climatic diagrams along with HI were utilized to investigate the weather-induced discomfort and its implications in the agricultural activities.

Under these circumstances, this study aims to investigate the degree of discomfortability (TD) in Guwahati by analysing various weather parameters i.e., Wet Bulb Temperature (WBT), Relative Humidity (RH),

Rainfall, Maximum Temperature (T_{max}), Minimum Temperature (T_{min}) etc. in monthly scale through Climograph and Hythergraph during both the periods of 1991-2020 and 2022-2024. In addition, HI is also calculated to determine the specific period in terms of months that are prone to TD in Guwahati. By assessing the relationships between temperature-humidity and temperature-rainfall on a monthly scale across these two time periods, this research provided a comprehensive understanding of the climatic discomfort experienced in the region. The findings will aid in developing mitigation strategies for heat stress, optimizing work schedules for outdoor activities like agriculture, and improving climate adaptation measures in both urban and rural settings.

2. Data and methodology

2.1. Study area

Guwahati is located in the Kamrup Metropolitan district (red point circle; Fig. 1) of Assam, one of the seven sisters, and the gateway to the northeast. According to the classification of ACZs, Kamrup Metropolitan falls under Lower Brahmaputra Valley Zones (Kundu *et al.*, 2025). The city receives around 1600 mm of annual cumulative rainfall, while the mean annual temperature is 23° C (Government of Assam, 2025a). The climate of Assam is typically 'Tropical Monsoon Rainforest Climate' with high humidity levels and heavy rainfall (warm summer and mild winter). Assam is also one of the richest biodiversity zones in the world for its well-known forest, wildlife, minerals, tea estate, etc (Government of Assam, 2025a, 2025b, 2025c). Guwahati experienced high temperatures and significant humidity, leading to elevated feel-like temperature (HI values) and substantial thermal stress. These conditions adversely affect agricultural productivity and livestock health, posing health risks to humans.

2.2. Datasets

The present investigation is based on the key weather parameters, e.g., Wet Bulb Temperature (WBT), Relative Humidity (RH), Rainfall, Maximum Temperature (T_{max}) and Minimum Temperature (T_{min}), which were obtained from the Data Supply Portal of IMD, weblink: <https://dsp.imdpune.gov.in/>). The data were compiled into a monthly scale during two periods of time, e.g., 1991-2020 and 2022-2024, for analysing the level of TD in Guwahati and compared accordingly. Monthly rainfall is represented cumulatively, while for the rest of the weather parameters (e.g., WBT, RH, T_{max} and T_{min}), mean values are considered during the compilation into a monthly scale. It is noted that a few current weather datasets were also collected from the Regional

TABLE 1

Scale of uncomfortability (after Taylor) with respect to the temperature range in °F

Range of Temperature (°F)	Scale of uncomfortability by Griffith Taylor (1949)
40-45	Very rarely uncomfortable
45-55	Ideal
55-60	Rarely uncomfortable
60-65	Sometimes uncomfortable
65-70	Often uncomfortable
70-75	Usually uncomfortable

Meteorological Centre (RMC), Guwahati office, time to time whenever required, which were not available with the IMD Data Supply Portal at the time of analysis.

2.3. Methods

2.3.1. Taylor's climograph

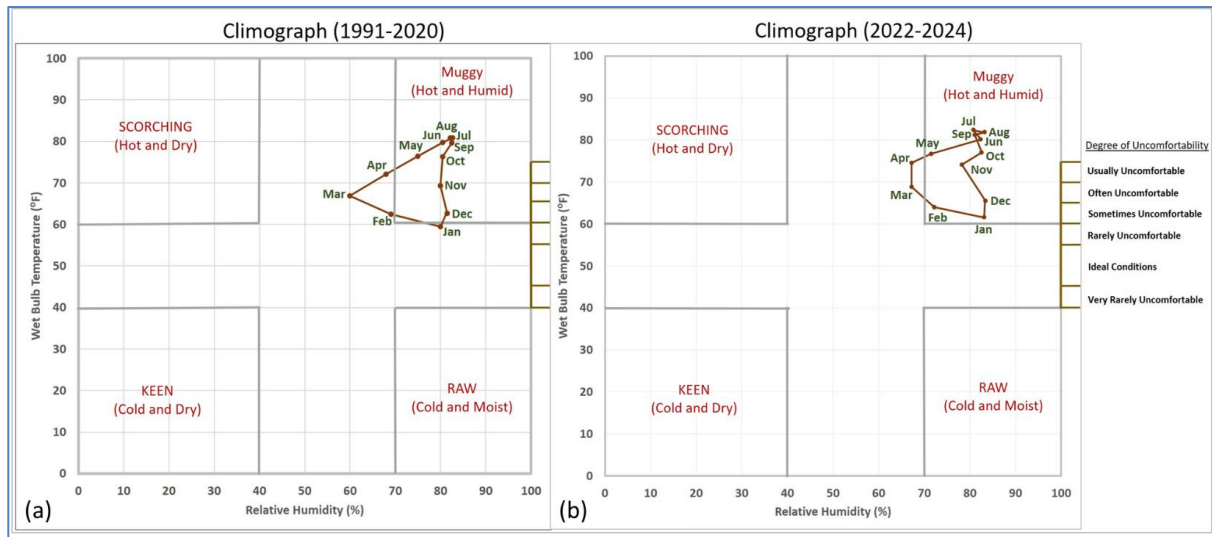
A Climograph is nothing but a short form of climatological diagram, which was invented by G. Taylor to compare Australian Cities concerning the ideal climate for the living of human beings, and this was further compiled to show the close similarity between tropical Australia and India (Taylor, 1918; Shaw, 1919; Monthly Weather Review, May 1920; O'brien, 2015). A Climograph is a twelve-sided polygon constructed for each month of the year to represent the climatic condition of a place for the identification of the discomfort (Table 1). The parameters considered for the Climograph are mean monthly RH (x-axis) in percentage (%) and WBT (y-axis) in degrees Fahrenheit (°F). The higher the temperature, along with increasing RH, makes a place more discomfort, i.e., *Muggy* (Hot and Humid) as prescribed by Taylor (1918).

2.3.2. Hythergraph

Like Climograph, Hythergraph also represent the climatic condition of a particular place and was originated by G. Taylor (Forbes, 1943). Hythergraph is also another twelve-sided polygon that represents cumulative monthly rainfall (x-axis) in cm and mean monthly temperature (y-axis) in °C of a particular place against one another. Based on the polygon that is represented by the Hythergraph is helpful to examine the hot and humid conditions of a place, as more rainfall along with higher temperatures make a place too discomfort.

2.3.3. Heat index (HI)

Heat Index, also known as apparent temperature, feels like to the human body when RH is combined with



Figs. 2(a&b). Graphical representation of the Climograph for Guwahati during (a) 1991-2020 and (b) 2022-2024, along with the degree of uncomfortability. Four square boxes inside Figure 2.a and 2.b show the climatic condition with respect to the position of a 12-sided polygon representing 12 months

Air Temperature (AT; here T_{max} and T_{min}). It is a crucial consideration for the human body's comfort – when the body gets too hot, it begins to perspire or sweat to cool itself off. If the perspiration is not able to evaporate, then the body cannot regulate its temperature. On the other hand, when perspiration evaporates off the body, it effectively reduces the body's temperature. While the atmospheric moisture content (i.e., RH) is high, the rate of evaporation from the body is decreased and, hence, the human body feels warmer in humid conditions. Therefore, a direct relationship existed between AT and RH, with the HI, as the AT and RH increased, HI also increased and vice versa (National Weather Services, 2025). The HI is calculated using the formula provided by the National Weather Service (NOAA), United States of America (weblink: <https://www.wpc.ncep.noaa.gov/html/heatindex.shtml>).

3. Results and discussions

3.1. Analysis of climograph

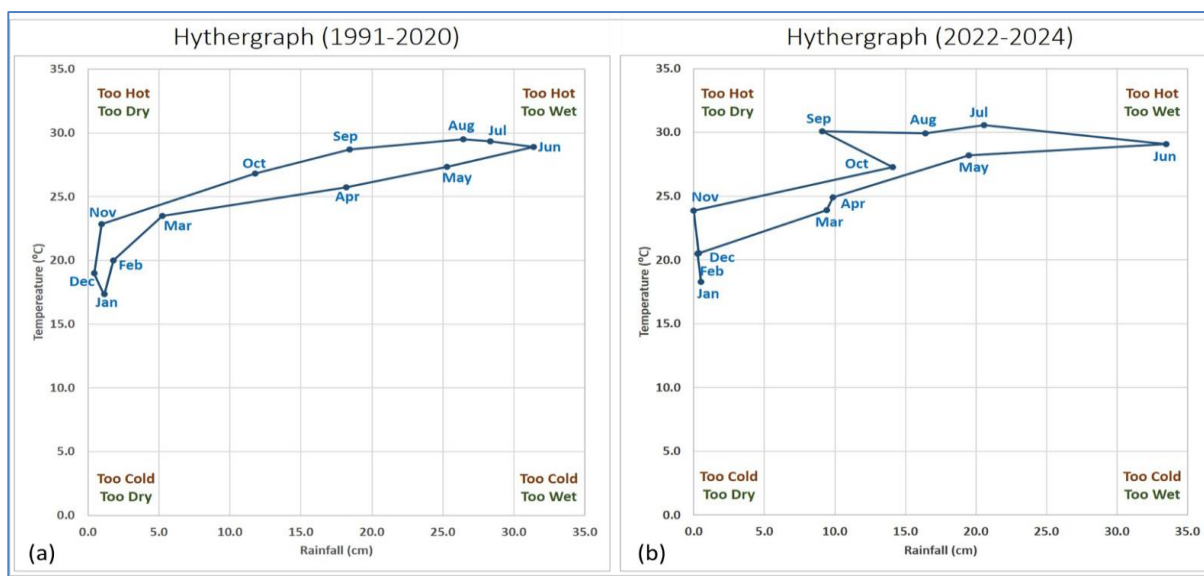
The highest degree of discomfort, which fell **beyond usually uncomfortable** as per the scale of “Degree of Uncomfortability” (as represented in Fig. 2 and Table 2), was found in May, June, July, August, September, and October during both time frames in Guwahati (as defined in Table 2). April is also falling beyond *usually uncomfortable* during 2022-24 (Fig. 2.b), while this month was *generally uncomfortable* during 1991-2020 (Fig. 2.a). On the other hand, the highest degree of comfort was observed in January during 1991-2020 in the form of *rarely uncomfortable*. January and February are

TABLE 2

Representation of the associated months with respect to the scale of “discomfortability” (after G. Taylor) during two time frames

Scale of discomfortability after Griffith Taylor (1949)	Associated Months	
	1991-2020	2022-2024
Very rarely uncomfortable	Nil	Nil
Ideal	Nil	Nil
Rarely uncomfortable	January	Nil
Sometimes uncomfortable	February and December	January and February
Often uncomfortable	March and November	March and December
Usually uncomfortable	April	November
Beyond Usually uncomfortable	May, June, July, August, September, and October	April, May, June, July, August, September, and October

sometimes uncomfortable, March and December are *often uncomfortable*, and November is *usually uncomfortable* during 2022-2024, as per the scale of uncomfortability provided by Taylor. On the other hand, March and November were *often uncomfortable*, and February and December were *sometimes uncomfortable* during 1991-2020. It is worth mentioning that *Ideal* and *very rarely uncomfortable* scenarios were not seen from the present analysis for Guwahati. Table 2 provides the names of the months during both the study periods, e.g., 1991-2020 and 2022-2024 and their association with the scale of discomfort as provided by G. Taylor.



Figs. 3(a&b). Graphical representation of the Hythergraph for Guwahati during (a) 1991-2020 and (b) 2022-2024. The cumulative rainfall and mean temperature for each 12 months are represented by 12 dots of the 12-sided polygon in Hythergraph

3.2. Analysis of hythergraph

As per the comparative analysis of Hythergraph (Fig. 3), it is noted that rainfall was decreased while temperature was increased at the same time in July, August and September during 2022-2024 (Fig. 3.b) compared to 1991-2020 (Fig. 3.a). In the case of June, rainfall increases with no significant changes in the temperature. Interestingly, rainfall was decreased in April and November during 2022-2024 compared to 1991-2020, while temperature increased in November, December, January and February. Therefore, it is implied from the Hythergraph of Guwahati that the monthly temperature is increased in most of the months, especially during the monsoon season, e.g., July, August and September.

3.3. Heat index analysis

According to the analysis of HI, T_{max} and T_{min} were considered and analysed for both during 1991-2020 and 2022-2024 and compared accordingly. It is noted that the T_{max} of HI was inferred from the monthly mean Tmax and its respective RH, while the T_{min} of HI was taken from the monthly mean Tmin and its respective RH. The T_{max} was recorded highest in September (55.5 °C), followed by July (53.6 °C) and August (53.3 °C) during 2022-2024 (Fig. 4.b). T_{max} was recorded lowest in January (25.7 °C) during the same period. In the case of Tmin, the highest HI was recorded in July (28.9 °C) and the lowest was recorded in January (10.7 °C).

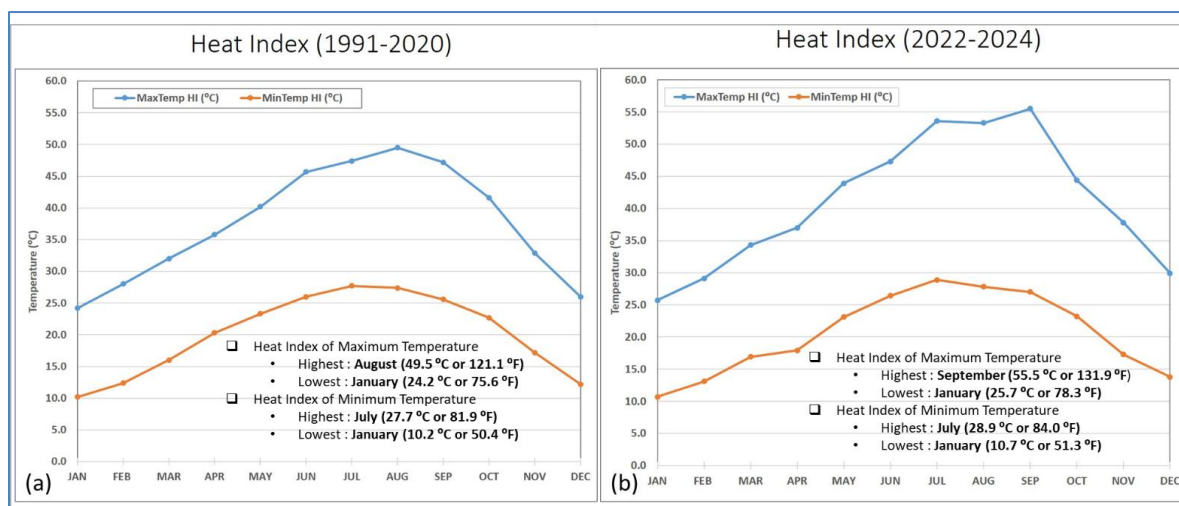
During the period 1991-2020 (Fig. 4.a), T_{max} was highest in August (49.5 °C) and lowest in January (24.2

°C), while T_{min} was highest in July (27.7 °C) and lowest in January (10.2 °C). Therefore, it is noted from the HI analysis that September was hotter and more humid in the recent period (2022-2024) compared to the climatological period (1991-2020) with an increase of 6 °C. It is also noted that RMC Guwahati issued a Special Hot and Humid Bulletin in September 2024 due to excessive warm conditions in Assam (IMD, 2024).

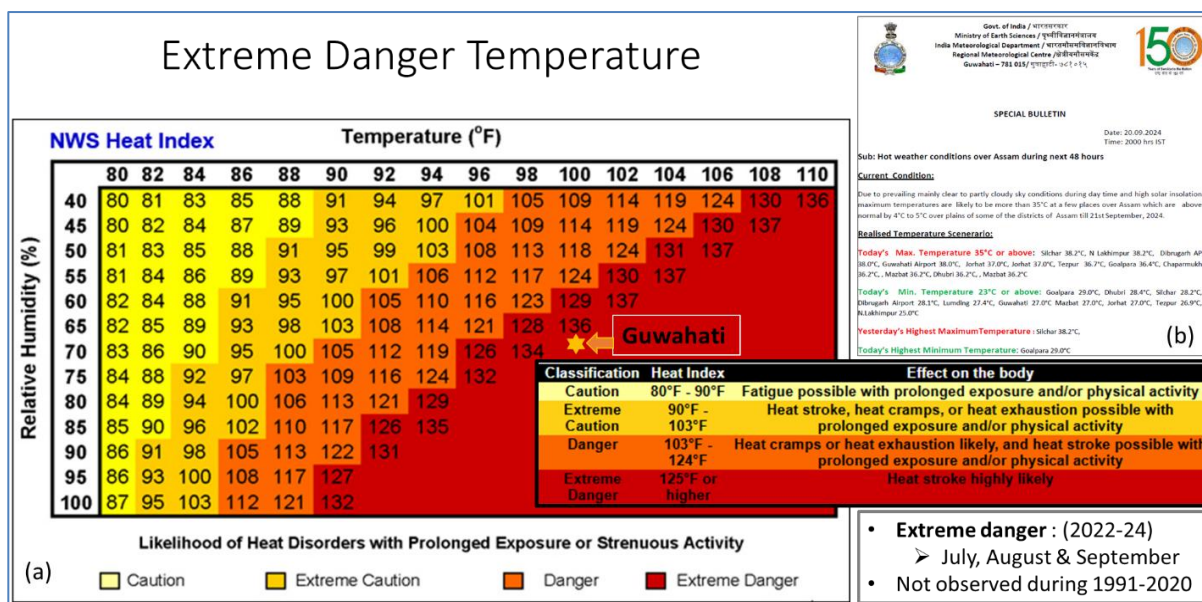
3.4. Assessment of extreme temperature and impacts on the agricultural practices

According to the assessment of the present study, it is observed that the *Extreme Danger* category belongs in July, August and September during 2022-2024, while nothing such was observed during 1991-2020. Due to the extreme danger of temperature, heatstroke is highly likely.

As per the Special Bulletin dated 20-09-2024 issued by the RMC Guwahati, IMD (Fig. 5.b), it is noted that T_{max} touched 38 °C in Guwahati with the RH of 67%, and hence, apparent temperature (HI) crossed 60 °C or 140° F (Fig. 5.a). This excessive temperature fell under *Extreme Danger* for the survival of human beings. On the other hand, hot and humid weather can have a significant affect on agriculture, where farming is treated as a key livelihood in states like Assam. Some potential impacts on the agricultural activities (Fig. 6) during the hot and humid conditions are mentioned, which were issued as a part of the Agrometeorological Advisory Service Bulletins (AABs) under Gramin Krishi Mausam Sewa (GKMS) rendered by the IMD, discussed below:



Figs. 4(a&b). Monthly Heat Index (HI) of Tmax and Tmin in degrees Celsius (°C) in Guwahati during (a) 1991-2020 and (b) 2022-2024



Figs. 5(a&b): (a) The extreme danger temperature inferred from the Heat Index (HI) during September in Guwahati, and (b) Special Bulletin issued by RMC Guwahati (IMD) due to the hot and humid weather for Assam. HI graphics source: National Weather Service (weblink: <https://www.weather.gov/ama/heatindex>)

(i) *Heat stress on crops*

Enhanced transpiration and moisture loss may result in plant wilting.

Elevated temperatures can negatively impact flowering, pollination, and fruit development.

A decline in soil moisture levels can adversely influence crop development.

(ii) *Livestock stress*

Decreased feed consumption and reduced milk yield are commonly observed in dairy animals.

The likelihood of heat stroke and dehydration tends to increase under such conditions

(iii) *Outbreaks of pests and plant diseases*

Elevated humidity levels can facilitate the development of fungal diseases in crops, such as leaf spot, powdery mildew, and bacterial wilt.

Warmer conditions can lead to a rise in pest populations, including aphids, whiteflies, and mites.

(iv) *Reduction in work efficiency*

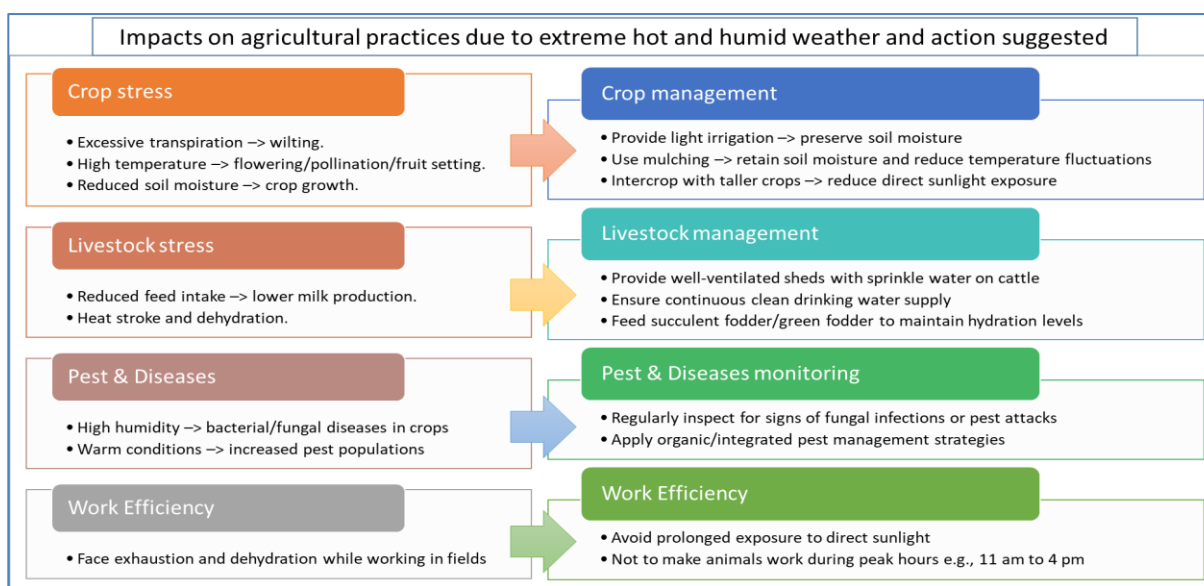


Fig. 6. Graphical representation of the impacts of the extreme hot and humid weather conditions on the agricultural practices and associated agrometeorological advisories to minimize these impacts

Exposure to harsh field conditions may lead to exhaustion and dehydration among farmers and agricultural labourers.

Agrometeorological advisories (Fig. 6) have also been provided to minimize the risk related to the hot and humid weather conditions on agricultural practices, which are mentioned below:

(v) Crop management

Irrigation: Apply light irrigation during early morning or late evening hours to preserve soil moisture and minimize crop water stress.

Mulching: Utilize materials such as straw, dry leaves, or plastic sheets to conserve soil moisture and moderate soil temperature variations.

Intercropping & Shade Crops: where feasible, cultivate shade-giving trees or practice intercropping with taller crops to minimize direct exposure to sunlight.

Pest & disease monitoring: Conduct regular monitoring for symptoms of fungal infections and pest infestations to implement organic or integrated pest management (IPM) practices accordingly.

(vi) Livestock management

Provide Shade & Ventilation: house livestock in well-ventilated shelters and ensure the availability of shade structures to reduce heat stress.

Hydration: maintain an uninterrupted supply of clean drinking water to support animal health and hydration.

Diet adjustment: Feeding succulent or green fodder supports optimal hydration and overall wellbeing in livestock.

Sprinkling Water: applying water sprays on cattle can aid thermoregulation and alleviate heat stress.

In addition, farmers and other agricultural workers are also advised to avoid prolonged exposure to direct sunlight during the peak hours to minimize their health risk. For animal husbandry, it is recommended not to make them work during the peak hours of the day, e.g., 11 am to 4 pm. It is also necessary to provide curtains and proper ventilation in poultry houses. Further, a graphical representation of the impacts of extremely hot and humid weather conditions and possible advisories to reduce the risk owing to the warm conditions are represented in Fig. 6.

4. Conclusions

The present study analysed various weather parameters through various climatic diagrams to assess the degree of TD in Guwahati, which is very crucial for crop productivity and agricultural workers. It was noted from the analysis that Guwahati falls under the “Muggy” category, which is hot and humid. TD is found in *extreme danger* during the monsoon season, especially in July, August and September due to the decrease in rainfall with increased temperature in Guwahati. The highest perceived

temperature was observed in September (55.5 °C or 131.9° F) during 2022-24 and August during 1991-2020 (49.5 °C or 121.1° F). In case of Climograph analysis, the highest degree of uncomfortability was also observed during the monsoon season (June to September) with more extreme conditions during 2022-24 compared to 1991-2020. According to Hythergraph analysis, rainfall decreased while temperature increased in the monsoon season except for June month. Further, the present study provided an impact-based assessment on the management of the crops and livestock due to the hot and humid weather perceived in Guwahati. This investigation will be helpful for policymakers to implement better agrometeorological advisories concerning the changing pattern of climate in Guwahati, as well as in Assam.

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Conflict of Interest Statement

The authors declare that there is no conflict of interest.

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Data availability

The weather parameters used in the present study are available with the Data Supply Portal of IMD at <https://dsp.imdpune.gov.in/>.

Authors' contribution

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