IMPACT OF CLIMATE CHANGE ON HEAT STROKE – AN INTERSTATE PANEL STUDY IN INDIA

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Abstract: Climate change has multi-dimensional effect among which effect on human health is most concerned. Farmers and workers of agricultural field are highly exposed to the vulnerability of climate change. In India 60 to 70% population is engaged directly or indirectly in agriculture, who is contributing 16 – 17% of the GDP. People engage in agriculture have to spend more than 6 to 7 hours in the field at day time, thus very much exposed to the sunlight. Sun stroke or heat stroke is one of the inevitable consequences of global warming. Present study tries to analyse the vulnerability of climate change on the basis of suffering from heat stroke by the people of different states of India. There is wide disparity among the states of India regarding heat stroke mortality but all are suffering from the harsh consequences of global warming. The study is to find out the effect of climate change on different states of India with respect to heat stroke mortality and to observe the effect of different heat indicators on human health. A 22 years interstate panel study compares this climate vulnerability in India in terms of death due to heat stroke. Descriptive study highlights state wise health hazard contemplating climate change. Index of death and heat intensity has been discussed by radars. Heat Intensity, Heat Intensity Square, Average Rainfall, Gross Sown Area Index etc. has significant effect on death. Few states like AP, UP, Odisha are very much exposed to the vulnerability. There is interstate heterogeneity in heat stroke mortality and other explanatory variables.

JEL: I12, Q51, Q54

Keywords: Climate Change, Global Warming, Heat Stroke, Death Due to Heat Stroke

Introduction

Rise in global average temperature (changing rate is twice as fast as in the last 50 years) leads to Climate change of the earth has multidimensional effect. Global surface temperature had been increased 0.74±0.18°C during the 100 years (1905-2005), which has changed the weather pattern of many geographical

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areas throughout the globe. The global warming generates adverse effect on climate and eventually harms all the existing living beings. World's poorer population is mostly exposed to this vulnerability of climate change. India is also facing the effect of global warming and climate change adversely [9]. In the past decades, there is enough evidence that the green house gases (GHGs) have played a significant role in the augmentation of global atmospheric temperature. CO_2, a major GHG is discharged from combustion of fossil fuels along with other GHGs like SO_2, Methane, nitrous oxide etc. which are responsible for enhancing the atmospheric temperature; hence it leads to global warming and climate change that creates manifold effects like rise in sea level, ocean acidification, cyclones, melting of glaciers, heat waves etc. Growing carbon emission is an alarming concern throughout the world as it is proportional to the development of a country. India, being a fourth largest carbon emitter [10], contributes 7% of total global emission preceded by china (27 %), United States (US) (15 %) and European Union (EU) (10%) [14].

A report of Intergovernmental Panel on Climate Change (IPCC) released in October, 2018 [16] has forewarned about the disastrous effect of recent trends of global warming if preventive measures are not adopted at once [1]. The report, has been analysed the impact of a 1.5^0C increase in global temperatures will "disproportionately affect disadvantaged and vulnerable populations through food insecurity, higher food prices, income losses, lost livelihood opportunities, adverse health impacts, and population displacements" [3]. India with high population density, inequality and poverty will face devastating consequences socially, politically and economically due to climate change. The 'life changing' report of IPCC investigates two main incidents to bother.

1. With large coast line and coastal habitation, sea level rise due to temperature hike may lead to catastrophic effect on coastal livelihood.

2. Deadly heat waves like 2015, killed thousands of people in India and Pakistan, may emerge as regular phenomena and city like Kolkata, India and Karachi, Pakistan may face worst challenges of global warming.

The report estimates that the above consequences can be minimised if proper action plan can be implemented which costs approximately $900bn. India is so disaster prone that 27 out of 35 states are in alarming condition. With an increase in the frequency of incidence of floods, hurricanes, and storms global warming may also pose a significant threat to the food security of India.

Understanding the different aspects of climate change, present study examines state wise heat stroke deaths in India with respect to heat intensity one of the inevitable consequence of global warming. The effect of heat intensity is different in different states depending on their topography and amount of GHGs emission. Therefore, there is a state wise

disparity in occurrence of deaths due to heat stroke which should be addressed for future abatement.

To estimate the relation between climate change and carbon dioxide emissions is not only complex but also depend on interactions between human emissions, carbon sinks, atmospheric concentrations and temperature change. Each emission of carbon dioxide results in the same global temperature increase, regardless of when or over what period of time the emission occurs [12]. The findings of the study are a tonne of carbon dioxide, will lead to 0.0000000000015 degrees of global temperature change. If we want to restrict global warming to no more than 2 degrees, we must restrict total carbon emissions from now until forever.

Literature Survey

14800 excess deaths due to extraordinary rise in maximum temperature occurred in Paris, 2003 which could be eliminated if prior protective technique were being taken [8]. It had been observed that systematic adaptation decreased the mortality of American people during 1990s. The excess death due to heat was high in 70s & 80s in US but they were able to control during 90s after adaptive policy implementation [7]. Heat stroke mortality is highly associated with elderly people. A study in Latin American cities reports that the mortality varies with age and sex [4]. Heat stroke in children of Muzaffarpur district, Bihar had been described with respect to clinico-epidemiological features. Children suffer from heat stroke is a recurring fact and the effect can be fatal if not attended instantly. The vulnerability is found in lower socio economic status, [15]. Excess mortality is strongly connected with heat wave of North India during May 2010. A month wise correlation between temperature and number of excess death over normal cases of deaths had been estimated which support that excess death occurred during the month of May, 2010 due to heat waves [2]. Effect of heat on health can be avoided if proper adaptive measures put into action. Though there are very little instances, but investigation suggests that adaptation may decrease the vulnerable consequences of climate change [5].

Objectives

The present study has been designed to consider the issues as follows.

1. The relation between heat intensity and heat stroke death.

2. The effect of cultivation in respect to gross sown area on heat death.

3. The role of average rainfall on the death mishap.

4. The relation between time and heat mortality.

5. The interstate comparison regarding the death due to heat stroke.

Methodology and Data

Increase in GHGs emission and gross sown area, rainfall etc. may have significant effect on occurrence of death due to heat stroke. Increase in GHGs emission and decrease in rainfall have substantial role in raising the global

temperature and heat related diseases. In order to increase the volume of agricultural output and providing people with adequate food we require larger gross sown area. Naturally, this will need more man power to be involved in the process of agricultural production. This means, more people are exposed to sunlight and hence it is likely to increase the propensity to heat stroke. To analyze the effect of rainfall, gross sown area, GHGs emission etc. on death due to heat stroke, a state wise secondary data has been collected from 1997 to 2015. Among 29 states 17 states are projected for the analysis. Data on different heat indicators of climate change for the remaining states are not available. Hypotheses have been tested to observe the significance of respective variables. Bar charts and radars are being used to summarize the interstate comparison. Panel regression has been carried out to estimate the relation among dependent variable and independent variables.

Specification and Measurement of Variables

Present paper tries to estimate the severity of climate change with respect to the death due to heat stroke. Usually, heat stroke occurs when body temperature rises up to 40^0C or above. Heat wave leads to increase the body temperature and the chance of stroke rise for the persons who are exposed to the heat for a long time. Due to climate change temperature of the earth surface has been increasing by 0.8^0C since more than hundred years. India is passing through a continuous and rapid increase in temperature since 1901 [13]. From the beginning of 20th century temperature of India has been increased by 1.2^0C compare to earth's mean temperature increase of 0.8^0C since 1880. i.e., India's rise in temperature is higher than the global change in temperature, which is not only alerting but also deadly [11]. In different parts of India heat wave is not only a very common phenomena in summer but also toll huge death. Punjab, UP, Andhra Pradesh, Maharashtra, Jharkhand, Orissa, West Bengal are some of the states witnessed much about regular heat stroke death. Therefore, it is necessary to analyze the effect of such rise in temperature on human health. Present study concentrates on death due to heat stroke, a result of rise in temperature in India since 1997, and factors on which the rise in temperature depends. Descriptive statistics has been provided to comprehend the nature of the Indian states on the basis of different indicators of climate change. For descriptive analysis bar chart and radar has been used. Fixed effect and Random effect model is used for the panel regression.

Panel regression has been carried out using 22 years of data on heat stroke for 17 states of India. This analysis will enable us to gauge a long term effect of rise in temperature experienced in our selected states. Regression analysis on Death due to Heat Stroke as Percentage of Total Death (TDHSAPTD) has been considered as the response variable. This variable is a percentage of state wise heatstroke death for a particular year to total death

of that state for the corresponding year. Heat Intensity, (HEATINTENCITY), Heat Intensity Square (HEATINTENCITYSQ), Gross Sown Area Index (GSAIN), Average Rainfall (AVRAINFALL) and Time are treated as explanatory variables.

In the model, green house gases CO_2, SO_2, NO_2, RSPM/PM10 and SPM are the significant sources of increase in heat. We find heat indicator by using max-min formula. Each indicator's value lies between 0 and 1. 0 means the minimum and 1 means maximum value of each indicator. Weighted average (weights being equal) of all these heat indicators have been considered as the indicator of heat intensity. Our vision is to look into the effect of heat intensity to increase the death. Heat intensity square (HEATINTENCITYSQ) has been used to measure the rate of change of heat stroke death due to heat. Dummy variables are used for the states in contrast with Andhra Pradesh.

Econometric Model

Panel regression has been articulated with a single response variable and five explanatory variables. The model is projected as follows:

LSDV model:

$$\text{. . . . . }_{it} = \alpha_1 + \alpha_2 \text{ Assam} + \alpha_3 \text{ Bihar} + \alpha_4 \text{Gujarat} + \alpha_5 \text{Haryana} + \alpha_6 \text{Jharkhand} + \alpha_7 \text{Karnataka} + \alpha_8 \text{ Kerala} + \alpha_9 \text{ Madhya Pradesh} + \alpha_{10} \text{ Maharashtra} + \alpha_{11} \text{ Orissa} + \alpha_{12} \text{ Punjab} + \alpha_{13} \text{ Rajasthan} + \alpha_{14} \text{ Tamil Nadu} + \alpha_{15} \text{ Tripura} + \alpha_{16} \text{ Uttar Pradesh} + \alpha_{17} \text{ West Bengal} + \beta_1 \text{ HEATINTENSITY}_{it} + \beta_2 \text{ HEATINTENSITYSQ}_{it} + \beta_3 \text{ GSAIN}_{it} + \beta_4 \text{ AVRAINFALL}_{it} + \beta_5 \text{ Time}_{it} + u_{it}$$

Here state dummies are used in contrast with Andhra Pradesh. Coefficients α_2, α_3, α_4, α_5, α_6, α_7, α_8, α_9, α_{10}, α_{11}, α_{12}, α_{13}, α_{14}, α_{15}, α_{16}, α_{17} are assigned for Assam, Bihar, Gujarat, Haryna, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal respectively.

Fixed Effect Model (FEM):

$$\text{TDHSAPTD}_{it} = \alpha + \beta_1 \text{ HEATINTENSITY}_{it} + \beta_2 \text{ HEATINTENSITYSQ}_{it} + \beta_3 \text{ GSAIN}_{it} + \beta_4 \text{ AVRAINFALL}_{it} + \beta_5 \text{ Time}_{it} + u_{it}$$

Hypothesis testing

The intended hypotheses for the model represented hereunder.

Hypothesis 1: Increase in heat intensity (HEATINTENCITY) affects the Death due to Heat Stroke as Percentage of Total Death (TDHSAPTD). Therefore the null hypothesis H_0:β_1=0 is to be tested against the alternative hypothesis H_1:β_1>0. There is a proportional relation among these two variables thus the coefficient β_1 should be positive.

Hypothesis 2: Heat intensity square (HEATINTENCITYSQ) is likely to have an effect on the Death due to Heat Stroke. Therefore, the null hypothesis is H_0:β_2=0 which should be checked in opposition to the alternative hypothesis H_1:β_2>0. If

Heat intensity square i.e. the rate of change of heat intensity increase the mortality rate will also increase, so the coefficient β_2 is positive.

Hypothesis 3: Whether Gross sown area index (GSAIN) has an influence on the heat stroke death or not that can be verified with the help of null hypothesis $H_0:\beta_3=0$ in contrast to the alternative hypothesis $H_1:\beta_3>0$. Rise in gross sown area means either more people are engage in agricultural activity and exposed to the sun ray or the agriculturists are exposed to sun ray for a longer time. Therefore, if the gross sown area increases then there is a chance that heat stroke death will increase leading to a proportional relation between GSAIN and heat stroke death supporting that the coefficient β_3 is positive.

Hypothesis 4: To test the effect of Average Rainfall (AVRAINFALL) on the heat stroke death, the required null hypothesis is, $H_0:\beta_4=0$ on the contrary the alternative hypothesis is $H_1:\beta_4<0$. Increase in Average Rainfall may help to decrease heat of the atmosphere and thus decrease the death. Hence more the rainfall less will be the heat stroke death making the coefficient β_4 negative.

Hypothesis 5: To observe whether Time is a responsible factor in determining the death due to heat wave or not, we have to test the null hypothesis $H_0:\beta_5=0$ against the alternative hypothesis$H_1:\beta_5>0$. More the years to go more will be the temperature of the environment as the cumulative emission of GHGs will increase and thus more will be the occurrence of death due to heat. So, there is proportional relation between heat stroke deaths and Time defining the positivity of the coefficient β_5.

Descriptive Statistics

Bar diagrams and Rader has been used to analyse the descriptive statistics of the study. Summary statistics has been presented on Gross Sown Area ('000 hectares), Average Rainfall during 1997-2018 and Total deaths and Sex-wise deaths during 1997-2018. Components of Climate Change during 1997-2018 and Index of Gross Sown Area ('000 Hectares) during 1997- 2018 are shown in Bar diagram. Rader has been used for Heat Intensity during 1997-2018 and Death due to Heat Stoke as Percentage to Total deaths. Diagrammatic Representation of Quantitative Variables is shown below.

Sex Wise and Total Deaths Due to Heat Stroke of the States during 1997-2018

Table 1 interpret that Average number of deaths due to heat stroke for male is higher than female for all the states considered here. As male are more exposed to the sun during day than female so the number of deaths is higher for male. Highest number of average male and female death has been recorded in Andhra Pradesh (AP) with 191 and 53 respectively followed by Uttar Pradesh (UP) with 116 male and 36 female death. Lowest number of average male and female death has been recorded in Assam with 5 and 2 respectively and second lowest is Tripura where the same is

recorded as 6 for male and 4 for female. Total number of death due to heat stroke is highest for Andhra Pradesh and lowest for Assam.

Table 1: Sex-wise and Total Deaths Due to Heat Stoke during 1997-2018

States	Average Number of Deaths due to Heat Stroke			
	Male	Female	Total	Total Death
AP	191	53	244	1647
Assam	5	2	7	178
Bihar	58	21	79	1511
Gujarat	25	6	31	2703
Haryana	36	7	43	552
Jharkhand	33	12	45	736
Karnataka	6	4	10	836
Kerala	4	6	10	359
MP	30	10	40	922
Maharashtra	49	11	60	1990
Orissa	64	17	81	1452
Punjab	88	8	96	721
Raj	32	9	41	1760
Tamil Nadu	15	9	24	763
Tripura	6	4	10	48
UP	116	36	152	3286
WB	49	24	73	1138

Source: www.indiastat.com

Summery Statistics

Table 2 shows the summery statistics of gross sown area and average rainfall during 1997 – 2018. Mean of gross sown area is highest for UP showing 25632.96 ('000 hectares) and lowest for Tripura with 373.84 (000 hectares). Coefficient of variation (CV) for gross sown area is highest for Orissa (32.13) and lowest for Punjab (0.55). Mean of average rainfall throughout 22 years is highest for Kerala (240 mm) per month and lowest for Rajasthan (40.03 mm) per month. CV of average rainfall is highest for karnataka (50.65) and lowest for West Bengal (10.63).

Table 2: Summary Statistics on Gross Sown Area ('000 hectares) and Average Rainfall during 1997-2018

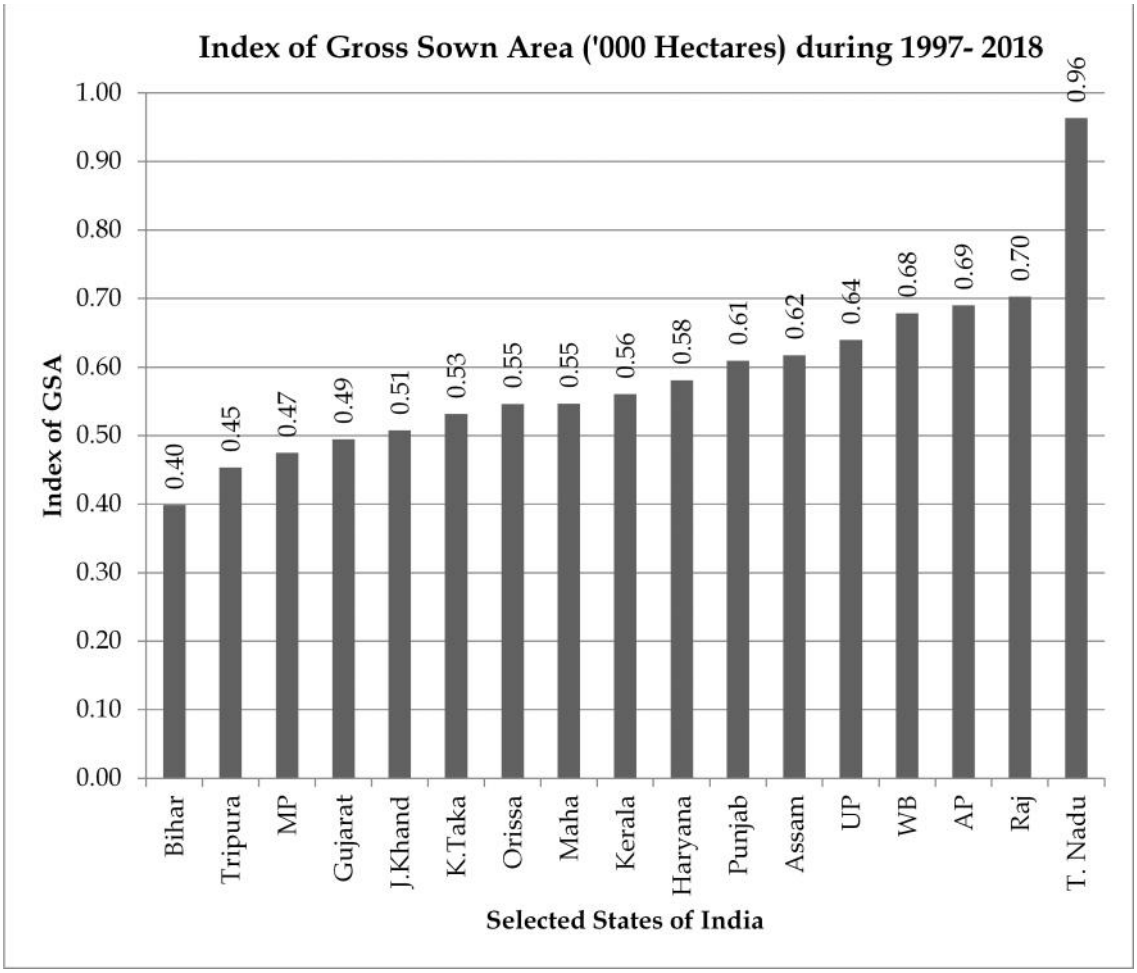
States	Gross Sown Area ('000 Hectares)		AV Rainfall (mm)	
	Mean	CV	Mean	CV
AP	12396.74	13.81	89.20	19.56
Assam	4016.85	2.55	201.04	16.00
Bihar	7952.31	13.70	92.32	21.29
Gujarat	11748.61	7.39	68.76	27.85
Haryana	6372.89	2.88	40.90	26.21
Jharkhand	1657.63	13.47	101.01	17.54
Karnataka	12306.92	3.85	103.37	50.65
Kerala	2802.92	6.63	240.00	12.36
MP	21826.62	11.60	85.20	16.11
Maha	22314.22	3.54	75.47	15.38
Orissa	7207.49	32.13	120.88	12.73
Punjab	7877.80	0.55	44.60	20.62
Raj	22285.01	13.01	40.03	22.54
Tamil Nadu	5871.87	7.61	80.98	17.29
Tripura	373.84	26.35	163.10	13.38
UP	25632.96	1.70	58.76	25.61
WB	9490.12	2.60	173.47	10.63

Source: https://rbi.org.in/Scripts/PublicationsView.aspx?id=18841, data.gov.in

Index of Gross Sown Area of Selected States of India

Chart1 exhibits the index of gross sown area of 17 states from 1997 to 2018. Highest index is observed for Tamil Nadu (0.96) and lowest for Bihar (0.40). Highest index represents higher gross sown area and vice versa. Therefore, Tamil Nadu achieved highest gross sown area and Bihar achieved lowest.

Chart 1

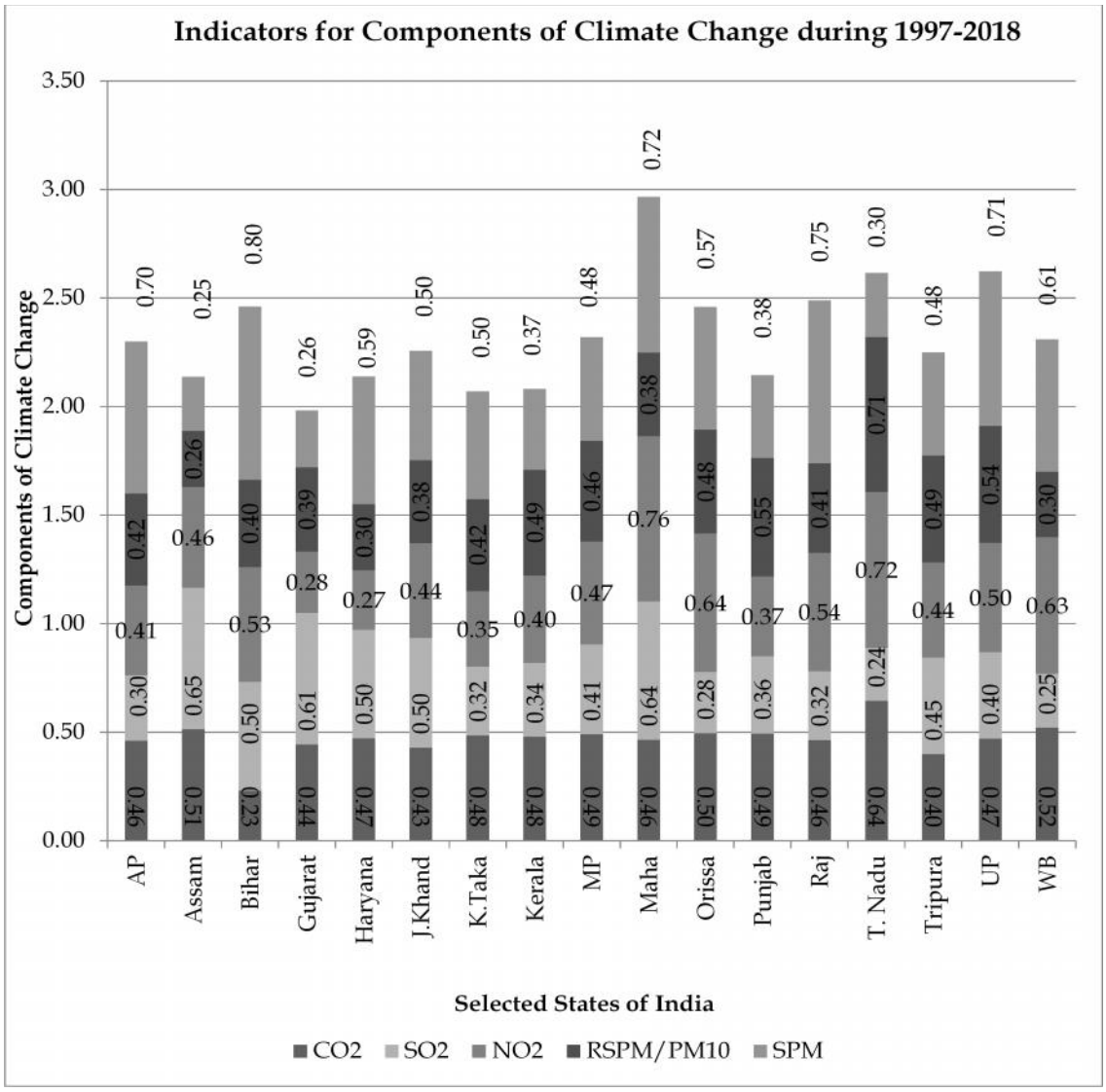


Source: https://rbi.org.in/Scripts/PublicationsView.aspx?id=18841

State Wise Indicators for Components of Climate Change of India

Chart 2 below shows indicators for component of climate change. GHGs like CO_2, SO_2, NO_2, RSPM/PM10 and SPM are taken into consideration as the components of climate change because the emission of these green house gases trap the surface temperature and exacerbate global warming. In the figure below, mean index of heat indicators are shown. State wise average index of emission of those GHGs during 1997-2018 are depicted through bar charts. Total of five heat indicators is highest for Maharashtra (2.96) and lowest for Gujarat (2). That means Maharashtra contributing highest GHGs to the atmosphere than other states of India.

Chart 2

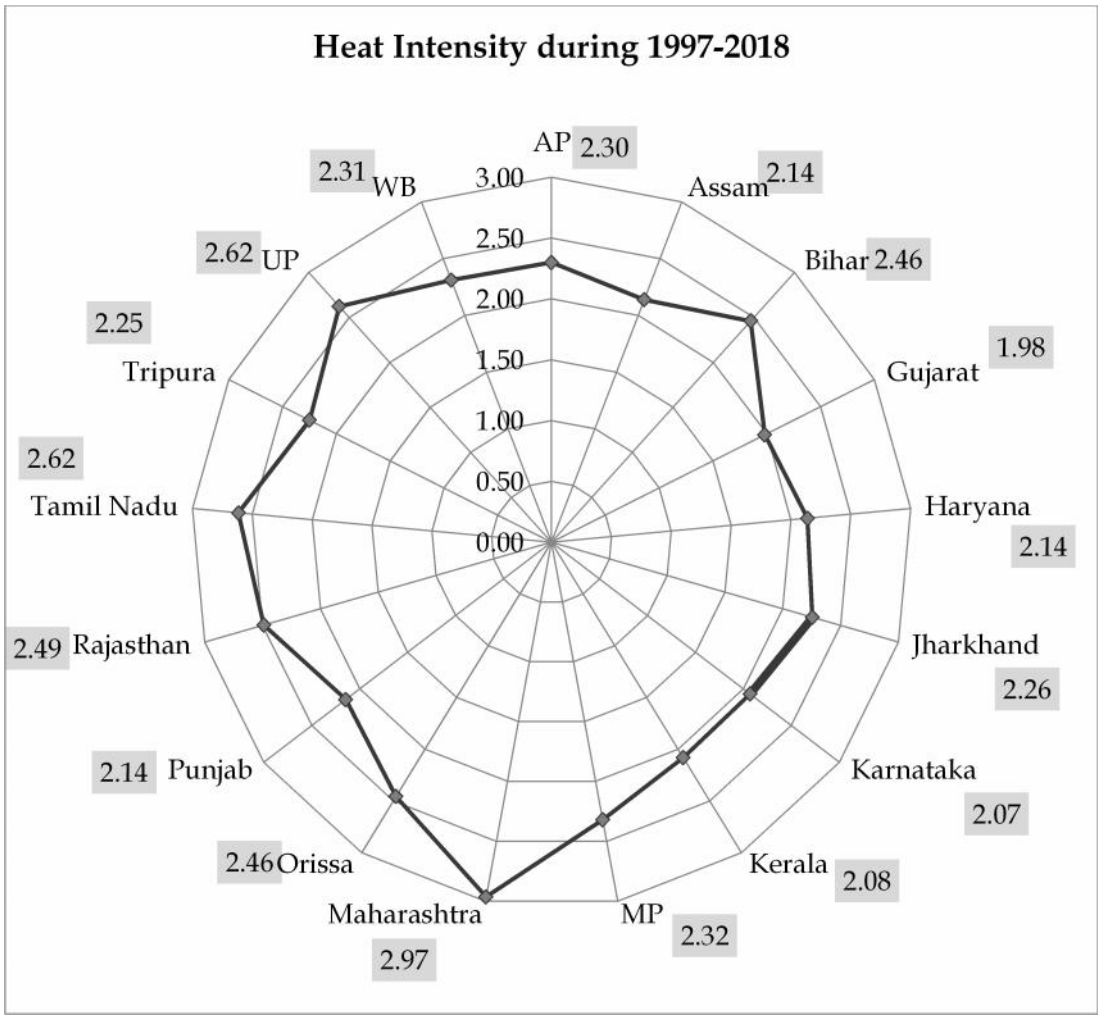


Source: data.gov.in

State Wise Heat Intensity

State wise heat intensity during 1997 to 2018 has been presented in Chart 3. Heat intensity is the summation of heat indicators which is highest for Maharashtra and lowest for Gujarat. Thus, Maharashtra has highest influence in increasing heat and Gujarat has lowest influence.

Chart 3

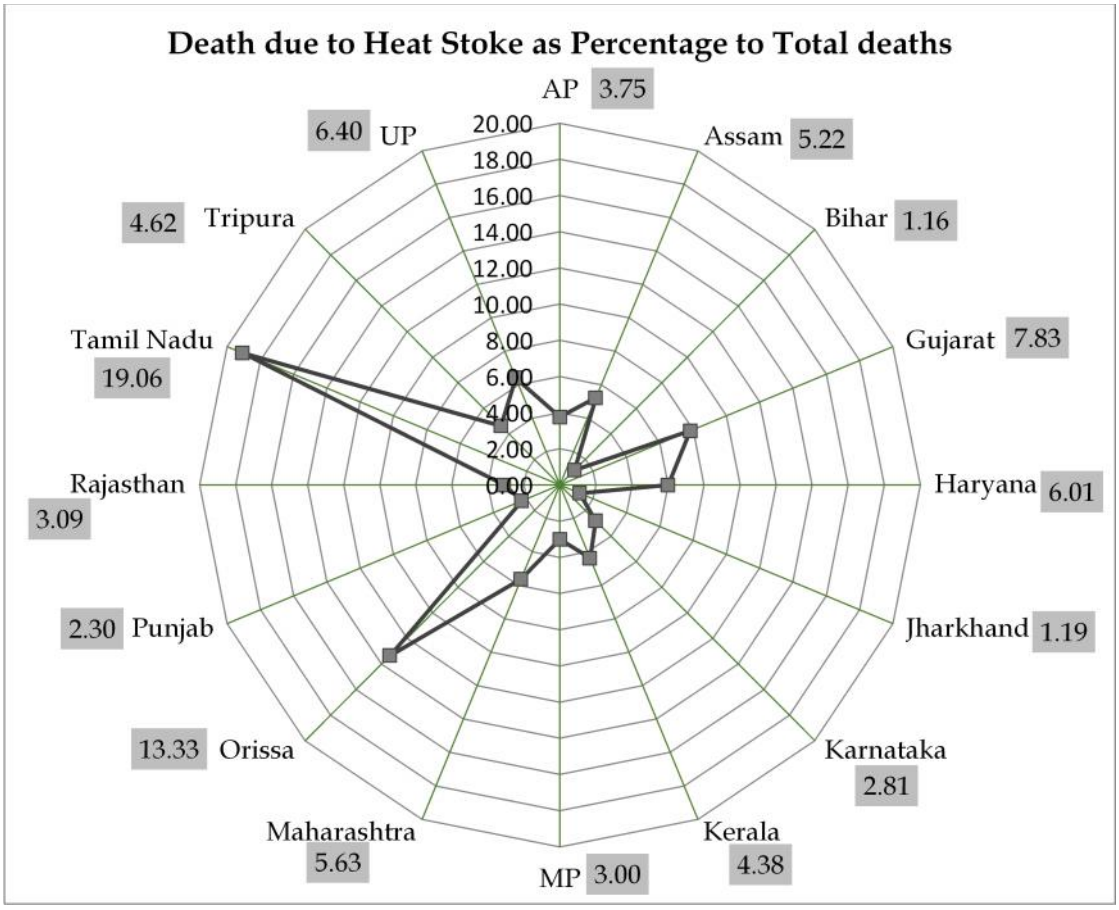


Source: data.gov.in

State Wise Death Due to Heat Stroke as Percentage to Total Death

Chart 4 exhibits death due to heat stroke as percentage of total death of each state. The radar shows that highest percentage of death occurred in Tamil Nadu (19.06) and lowest in Bihar (1.16). That means heat stroke death is higher in percentage in Tamil Nadu but lowest in Bihar compare to total death.

Chart 4



Source: www.indiastat.com

Regression Analysis on Death Due to Heat Stroke

LSDV: Fixed Effect Model

In LSDV model (FEM), regression analysis carries with Death due to Heat Stroke as Percentage of Total Death (TDHSAPTD) as dependent variable. Explanatory variables are Heat Intensity (HEATINTENCITY), Heat Intensity Square (HEATINTENCITYSQ), Gross Sown Area Index (GSAIN), Average Rainfall (AVRAINFALL) and Time (Time). Here use state dummies for each state with AP as contrast. We compare the coefficients of other states with AP and observe that the coefficients of all states are smaller than AP and all are significant at 1% level of significance only coefficient of Punjab is insignificant. Thus all other states are superior to AP in terms of coefficient in regression except Punjab.

Table 3: Estimates of LSDV Model (Fixed Effect Model) on Death due to Heat Stroke as Percentage of Total Death

TDHSAPTD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
HEATINTENSITY	0.62133	0.19971	3.111	0.000	0.33731	1.01286
HEATINTENSITYSQ	0.70595	0.19862	3.554	0.000	0.31532	1.09658
GSAIN	1.18729	0.53810	2.206	0.028	0.12899	2.24559
AVRAINFALL	-0.01308	0.00724	-1.806	0.072	-0.02733	0.00117
Time	0.25282	0.05829	4.337	0.000	0.13818	0.36745
State_ID						
Assam	-7.03594	1.20497	-5.839	0.000	-9.40580	-4.66609
Bihar	-8.21099	0.91509	-8.973	0.000	-10.01071	-6.41127
Gujarat	-10.91070	0.92536	-11.791	0.000	-12.73064	-9.09077
Haryana	-5.27286	0.98697	-5.342	0.000	-7.21396	-3.33176
Jharkhand	-7.05685	0.90472	-7.800	0.000	-8.83619	-5.27752
Karnataka	-10.79405	0.90967	-11.866	0.000	-12.58313	-9.00498
Kerala	-7.60378	1.41352	-5.379	0.000	-10.38379	-4.82378
Madhya Pradesh	-7.63263	0.90208	-8.461	0.000	-9.40677	-5.85850
Maharashtra	-6.75876	0.96545	-7.001	0.000	-8.65753	-4.85998
Orissa	-6.96280	0.93445	-7.451	0.000	-8.80060	-5.12500
Punjab	0.39798	0.95627	0.416	0.678	-1.48274	-2.27871
Rajasthan	-12.03154	0.96603	-12.455	0.000	-13.93146	-10.13163
Tamil Nadu	-9.76626	0.91659	-10.655	0.000	-11.56894	-7.96357
Tripura	7.84851	1.12194	6.995	0.000	5.64195	10.05506
Uttar Pradesh	-9.57499	0.93274	-10.265	0.000	-11.40943	-7.74055
West Bengal	-3.43001	1.08154	-3.171	0.002	-5.55711	-1.30291
_cons	8.74090	1.63029	5.362	0.000	5.534561	1.94724

Source: www.indiastat.com, data.gov, https://rbi.org.in/Scripts/Publications View.aspx?id=18841

LSDV model (Fixed Effect Model), Table 3, shows that the explanatory variable Heat Intensity (HEATINTENCITY) is significant at 1% level and positive, implying that heat stroke deaths increase if heat intensity increase. Heat Intensity Square (HEATINTENCITYSQ) is also significant at 1% level and positive, implying that the rate of change of heat stroke deaths increase if rate of change of heat intensity increase. Gross Sown Area Index (GSAIN) is significant at 5% level and positive, i.e. heat stroke deaths will increase if gross sown areas increase. Average Rainfall (AVRAINFALL) is significant at 10% level and negative, i.e. decrease in heat stroke death due to increase in Average Rainfall as rainfall decreases the temperature of atmosphere. Time is significant at 1% level and positive, i.e. heat stroke death increases if time goes on.

Random Effect Model

In Random Effect Model (REM), explanatory variable HEATINTENCITY and AVRAINFALL is insignificant. HEATINTENCITYSQ and Time is significant at 1% level and GSAIN is significant at 5% level. REM is shown in Table 4.

Table 4: Estimates of Random Effect Model on Death due to Heat Stroke as Percentage of Total Death

Random-effects GLS regression			Number of obs =	374		
Group variable: State_IDNumber of groups =			17			
R-sq:			Obs per group:			
within = 0.5988			min =	22		
between = 0.0356			avg =	22		
overall = 0.2954			max =	22		
Wald chi2(5) =	520.21					
corr(u_i, X) = 0 (assumed)			Prob> chi2 =	0.0000		
TDHSAPTD	**Coef.**	**Std. Err.**	**z**	**P>|z|**	**[95% Conf.**	**Interval]**
HEATINTENSITY	1.16213	1.10971	1.04724	0.295	-3.33713	1.01286
HEATINTENSITYSQ	0.75239	0.19904	3.78014	0.000	0.36228	1.14249
GSAIN	1.15878	0.54011	2.14545	0.032	0.10018	2.21739
AVRAINFALL	-0.01063	0.00682	-1.55868	0.119	-0.02399	0.00274
Time	0.25772	0.05833	4.41866	0.000	0.14341	0.37204
_cons	2.59652	1.82562	1.42227	0.155	-0.98163	6.17466
sigma_u	= 4.3746112					
sigma_e	= 2.9597154					
rho	= 0.6859923	(fraction of variance due to u_i)				

Source: www.indiastat.com, data.gov, https://rbi.org.in/Scripts/Publications View.aspx?id=18841

Hausman Test

Hausman test for choice between Fixed Effect Model (FEM) And Random Effect Model (REM) on Death due to Heat Stroke as Percentage of Total Death is explained in table 5. Fixed effect model (FEM) is considered for regression as Hausman test (Table 5) accepts the FEM than REM at 10% level of significance, describes that the null hypothesis of accepting REM is rejected, thus accepting FEM. Therefore our concerned model is FEM to express the relation between response variable and explanatory variables.

Table 5: Hausman Test for Choice between Fixed Effect and Random Effect Model on Heat Stroke Deaths

	COEFFICIENTS		(b-B)	sqrt(diag(V_b-V_B))
	(b)	(B)		
	fem	rem	Difference	S.E.
HEATINTENCITY	0.62133	-1.16213	1.78346	0.10312
HEATINTENCITYSQ	0.70595	0.75239	-0.04644	0.01710
GSAIN	1.18729	1.15878	0.02851	0.03452
AVRainfall	-0.01308	-0.01063	-0.00245	0.00257
Time	0.25282	0.25772	-0.00491	0.00591
b= consistent under Ho and Ha; obtained from xtreg B = inconsistent under Ha, efficient under Ho; obtained from xtreg				
Test: Ho: difference in coefficients not systematic				
chi2(4) = (b-B)'[(V_b-V_B)^(-1)](b-B) = 12.17 Prob>chi2 = 0.0514				

Source: www.indiastat.com, data.gov, https://rbi.org.in/Scripts/PublicationsView.aspx?id=18841

Fixed Effect Model

Table 6 shows fixed effect regression on Death due to Heat Stroke as Percentage of Total Death. From the table it can be perceived that explanatory variables HEATINTENCITY, HEATINTENCITYSQ and Time are significant at 1% level. GSAIN is significant at 5% level. AVRAINFALL is insignificant. Hence we may conclude that all the variables have imperative role in increasing the heat stroke deaths except rainfall.

Table 6: Fixed Effect Model on Heat Stroke Deaths

Fixed-effects (within) regression					Number of obs = 374	
Group variable: State_ID					Number of groups = 17	
R-sq:					Obs per group:	
within = 0.5989					min = 22	
between = 0.0244					avg = 22	
overall = 0.2866					max = 22	
					F(5,352) = 105.14	
corr(u_i, Xb) = -0.0266					Prob> F = 0.000	
TDHSAPTD	**Coef.**	**Std. Err.**	**z**	**P>|z|**	**[95% Conf. Interval]**	
HEATINTENCITY	0.62133	0.19971	3.11113	0.000	0.33713	1.01286
HEATINTENSITYSQ	0.75239	0.19904	3.78014	0.000	0.36228	1.14249
GSAIN	1.15878	0.54011	2.14545	0.032	0.10018	2.21739
AVRAINFALL	-0.01063	0.00682	-1.55868	0.119	-0.02399	0.00274
Time	0.25772	0.05833	4.41866	0.000	0.14341	0.37204
_cons	2.59652	1.82562	1.42227	0.155	-0.98163	6.17466
sigma_u	4.3746112					
sigma_e	2.9597154					
rho	0.68599233	(fraction of variance due to u_i)				

Source: www.indiastat.com, data.gov, https://rbi.org.in/Scripts/PublicationsView.aspx?id=18841

Policy Prescriptions and Suggestions

Few policy prescriptions are recommended to control death due to heat stroke considering the regression analysis.

Policy Prescriptions

1. **Decrease in Heat Intensity:** It is observed that the components of climate change (namely CO_2, SO_2, NO_2, RSPM/PM10 etc.) should be controlled to

regulate the heat of atmosphere. Our government must take plan and policies to eliminate the effect of GHGs which ultimately help in decreasing the death and devastating effects of climate change.

2. **Afforestation**: Our estimation suggests that there is negative relation between heat stroke death and rainfall. If rainfall increases the death due to heat stroke will be regulated. Measures should be taken for afforestation in order to increase the quantity of rain fall. Planting trees or creating forest is a good option to fight against the climate change and global warming. Local government as well as NGOs may take the responsibility of creating such forest.

3. **Increase in Budgetary expenditure to combat global warming:** Though huge fund is required to take the necessary steps to cut down the GHGs emission in controlling the future temperature increase, an especial budgetary allotment is necessary.

4. **Implementation of improved technology for cultivation**: Dependency on agriculture should be decreased and new technology and intensive cultivation should be adopted by Indian farmers so that the gross sown area may decrease as well as GHGs emission from the agricultural field could be minimized.

Suggestions

In accordance to the growing need of food production gross sown area of our country will increase day by day. Again industrialization is also very important for economic growth. Both will further increase the emission of different GHGs and atmospheric temperature. Therefore, it is utmost important to implement some adaptive measures to combat the devastating effect of global warming. Electronic media can play important role in spreading the consciousness among the people who are going to face the consequence. To fight against Heat intensity, policy may be undertaken to create awareness of global warming by the government so that common people can understand the future threat of climate change and can adopt proper technology to minimize household emission. Government can arrange different adaptation implementation program and technique to protect the people from deadly effect of heat [1].

Conclusion

Heat stroke death is wide spread in India since 1901(6). Few states like AP, UP, Orissa are very much exposed to the vulnerability. Tamil Nadu scored highest percentage of heat stroke death along with highest gross sown area index. Maharashtra emits highest GHGs in the environment as total of average heat indicators is highest. Heat intensity, gross sown area and time have significant impact on increasing the death. Rainfall can regulate the heat mortality. There is heterogeneity in state wise death due to heat stroke and other explanatory variables. Few states like Maharashtra, UP etc. are generating more components of heat which adversely affect global warming where as Gujarat shows the lowest. Sates like Assam, Tripura show

low mortality due to heat. The states in India are obtaining different socio-economic conditions as well as different topography, therefore, the effects and consequences of global warming are different at different places. Our government should take rapid action plan to overcome the future effect of climate change and protect the mankind immediately.

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