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IMPACT OF CLIMATE CHANGE ON HUMAN HEALTH IN INDIA

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INTRODUCTION

Climate change is a threat to both mankind and any life from existing on planet earth. Since the end of the 19th century, the earth's average surface temperature has increased by 0.3 to 0.6 Degree C. Over the last 40 years, the rise has been 0.2 to 0.3 Degree C (Kumar:June 2009).Climate change is defined as the long term change in earth's climate due to natural, mechanical and anthropological processes which result in emission of green houses gases like CO2, methane, etc. These gases settle in the stratosphere and trap the heat within the atmosphere leading to global warming and changing climate patterns (Editorial Desk, Yojana, December 2015). According to the Inter Governmental Panel on Climate Change (IPCC),"Climate change as a change in the state of the climate that can be identified (e.g., using statistical tests) by changes in the mean and or variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity".

HEALTH & HEALTH HAZARDS:

The World health Organization (WHO) is placing health at the centre of global dialogue by making it the theme of the World Health Day, April 7. The objective of World Health Day is to catalyze public participation in the global campaign to protect health from the adverse effects of climate change. Health hazards from climate change are diverse and global in nature. The hazards range from higher risks of extreme weather events to changes in the dynamics of infectious diseases (Madhavan,Yojana, June 2008). For India, nearly 700 million of her over one billion population living in rural areas directly depends on climate-sensitive sectors (agriculture, forests, and fisheries) and natural resources (such as water, biodiversity, mangroves, coastal zones, grasslands) for their subsistence and livelihoods. Heat waves, floods and droughts occur commonly. Malaria, malnutrition, and

diarrhea are major public health problems (Srivani,Yojana, April 2010). These impacts will be disproportionately greater in vulnerable populations, which include the very young, elderly, medically infirm, poor and isolated populations. Vulnerability is also high in:

- Areas with a high endemicity of climate-sensitive diseases, severe water scarcity, and low food production;
- Small-island developing states and mountainous regions; and
- Megacities and coastal areas in developing countries (Madhavan,Yojana, June 2008).

IMPACT ON HUMAN HEALTH:

"Climate Change is projected to increase threats to human health."

(……3AR, The United Nation's IPCC)

Global warming will directly affect human health by increasing cases of heat stress. It would cause new diseases both in humans and cattle and outbreaks of epidemics will increase (Kumar, Yojana, June 2009). Excessive monsoon rainfall and high humidity will enhance mosquito breeding. Human health is also affected by cyclone, drought and heavy rainfall. Climate change will reduce food production which will lead to hunger and malnutrition (Kumar, Yojana, June 2008). There is a high incidence of occurrence of vector borne diseases like Malaria, Kala-azar, Japanese Encephalitis, Filaria, Chikungunia etc., in the immediate past. It is observed that changes in climate patterns may alter the distribution of vector species and increase its spread in new areas. An increase in temperature and relative humidity may enlarge the transmission windows. Effluent emissions to water bodies and salination of rivers through sea level rise may increase the incidence of water borne diseases (MSPI, Govt. of India,2015). Srivani in her article 'Impact of Climate Change on Human health in India' said the following impacts:

- Extreme high air temperatures can kill directly. Heat waves directly contribute to deaths from cardiovascular and respiratory diseases, especially among the elderly people.
- Warmer temperatures, shifting rainfall patterns and increasing humidity affect the transmission of diseases by vectors like mosquitoes.
- The increase of Chloro Fluoro Carbons in the atmosphere, leading to global warming will increase UV radiation in the atmosphere, affecting the immune systems and leading to infectious diseases. The UV

radiation affects the immune system of the skin and hence there might be an increased number of cases of skin cancer.

- Increasing traffic and exhaust as well as industrial emissions are raising concentrations of SO2, N2O, O3 and suspended particulate matter, which are known to be damaging to human health.
- Pollen and other allergens in the air trigger and aggravate asthma and cardiovascular respiratory diseases.
- Rising temperatures, changing patterns of rainfall and more frequent droughts and floods are projected to decrease crop yields in many developing countries causing shortage of food supplies. This could result in severe malnutrition and under nutrition, especially among children, in countries where large populations depend rain-fed farming at subsistence level.

Some health effects of climate change are less direct and involve changes in our environment that in turn can affect human health and diseases. Examples of the varied ways that climate change can affect people's health are shown in the following table:

Examples of Climate Change Impacts on Health

	CLIMATE DRIVER	EXPOSURE	HEALTH OUTCOME	IMPACT
Extreme Heat	More frequent, severe, prolonged heat events	Elevated temperatures	Heat related death and illness	Rising temperatures will lead to an increase in heat related deaths and illness
Outdoor Air Quality	Increasing temperatures and changing precipitation patterns	Worsened air quality(ozone, particulate matter, and higher pollen counts)	Premature death, acute and chronic cardiovascular and respiratory illnesses	Rising temperatures and wildfires and decreasing precipitation will lead to increase in ozone and particulate matter, elevating the risks of cardiovascular and respiratory illnesses and death.
Flooding	Rising sea level and more frequent or intense extreme precipitation, hurricanes, and storm surge events	Contaminated water, debris, and disruptions to essential infrastructure	Drowning, injuries, mental health consequences, gastrointestinal and other illness	Increased coastal and inland flooding exposes populations to a range of negative health impacts before, during, and after events.
Vector-borne	Changes in	Earlier and	Lyme disease	Ticks will show earlier

Infection (Lyme disease)	temperature extremes and seasonal weather patterns	geographically expanded tick activity		seasonal activity and a generally northward range expansion, increasing risk of human exposure to Lyme disease- causing bacteria.
Water related Infection (Vibrio vulnificus)	Rising sea surface temperature, changes in precipitation, and runoff affecting coastal salinity	Recreational water or shellfish contaminated with Vibrio vulnificus	Vibrio vulnificus induced diarrhea and intestinal illness, wound and bloodstream infections, death.	Increases in water temperatures will alter timing and location of Vibrio vulnificus growth, increasing exposure and risk of waterborne illness.
Food-related Infection (Salmonella)	Increasing in temperature, humidity and season length	Increased growth of pathogens, seasonal shifts in incidence of Salmonella exposure.	Salmonella infection, gastrointestinal outbreaks.	Rising temperatures increase Salmonella prevalence in food; longer seasons and warming winters increase risk of exposure and infection
Mental Health & Well Being	Climate change impacts especially extreme weather	Level of exposure to traumatic events, like disasters	Distress, grief, behavioral health disorders, social impacts, resilience.	Changes in exposure to climate or weather related disasters cause or exacerbate stress and mental health consequences, and with greater risk for certain populations.
Source: USGCRP(2016),The Imp[acts of Climate Change on Human Health in the United States: A Scientific Assessment. Crimmins, A. & others, Global Change Research Program, Washington, DC.				

AIR POLLUTION, CLIMATE CHANGE AND HEALTH HAZARDS:

Climate and pollution challenged world, public health is at serious risk from the ominous trends in toxic air pollutants and warming gases. The recent Global Burden of Disease (GBD) estimates shows that in India alone, more than 627,000 people die prematurely and 18 million healthy life years are lost every year due to ill health connected especially with tiny particles. According to the GBD, toxic air worsens symptoms of ischemic heart disease, stroke, chronic obstructive pulmonary disease, asthma, lung cancer and acute lower respiratory tract infection. This causes premature deaths and loss of healthy life years due to illness. A range of toxic pollutants and the warming gases are co-emitted from vehicles, industry, power plants and cooking stoves, in urban and rural environment. Studies have shown that each increase of 1 degree Celsius caused by carbon dioxide

concentration can enhance particulate and ozone build up. This can lead to thousands of additional deaths and many more illness (Roychowdhury, Yojana, December 2015).

SOME RECOMMENDATIONS:

The following recommendations have made by World Bank in this regard (Climate, Climate Change and Human health in Asian cities, Kovats & Akhtar, Environment and Urbanization Magazine, 1st April 2008):

- Reliable and comprehensive assessments of risk vulnerabilities for exposed cities, and the dissemination of such information;
- Establishment of early warning systems and evacuation plans, including emergency preparedness and neighbourhood response systems;
- Improved efficiency of the water supply management;
- Improving health educational and institutional capacity in urban environment management; and
- Regularizing property rights for informal settlements and other measures to allow low-income groups to buy rent or build good quality housing on safe sites.

So, we can say that, preventive approach is essential for protection of health from climate change.

Malaria Cases and Deaths in the Country since 2012

State/UTs	2012			2013			2014			2015*		
	Malaria cases	Pf cases	Deaths	Malaria cases	Pf cases	Deaths	Malaria cases	Pf cases	Deaths	Malaria cases	Pf cases	Deaths
Andhra Pradesh	24699	15695	2	19787	13385	0	21077	15511	0	13509	11014	0
Arunachal Pradesh	8368	2789	15	6398	2118	21	6082	2338	9	3316	777	0
Assam	29999	20579	13	19542	14969	7	14540	11210	11	8402	6251	0
Bihar	2605	838	0	2693	715	1	2043	699	0	843	387	0
Chhattishgarh	124006	96924	90	110145	89418	43	128993	108874	53	55648	47392	5
Goa	1714	170	0	1530	131	0	824	42	0	263	23	0
Gujarat	76246	10483	29	58513	9122	38	41608	6253	16	13270	1075	0
Haryana	26819	569	1	14471	247	3	4485	45	1	670	2	0
Himachal Pradesh	216	3	0	141	0	0	102	1	0	21	1	0
Jammu & Kashmir	864	34	0	698	24	0	291	21	0	65	3	0

Jharkhand	131476	48188	10	97786	38263	8	103735	46448	8	26915	12264	1
Karnataka	16466	1278	0	13302	967	0	14794	1329	2	5715	465	0
Kerala	2036	236	3	1634	243	0	1751	305	6	773	193	1
Madhya Pradesh	76538	24039	43	78260	28775	49	96879	41638	26	17760	5826	4
Maharashtra	58517	11875	96	43677	9198	80	53385	25770	68	20829	9455	13
Manipur	255	83	0	120	42	0	145	72	0	106	54	0
Meghalaya	20834	19805	52	24727	22885	62	39168	37149	73	20881	19347	44
Mizoram	9883	9437	25	11747	10340	21	23145	21083	31	13600	11900	0
Nagaland	2891	821	1	2285	519	1	1936	647	2	661	215	2
Odisha	262842	244503	79	228858	208488	67	395035	342280	89	233070	194133	44
Punjab	1689	43	0	1760	31	0	1036	14	0	174	1	0
Rajasthan	45809	1394	22	33139	1086	15	15118	603	4	2032	68	0
Sikkim	77	14	0	39	13	0	35	18	0	14	5	0
Tamil Nadu	18869	576	0	15081	539	0	8729	339	0	2795	109	0
Telengana	--	--	--	--	--	--	5189	4602	0	1718	1483	1
Tripura	11565	10915	7	7396	6998	7	51240	49653	96	18231	16944	14
Uttarakhand	1948	111	0	1426	108	0	1171	89	0	369	17	0
Uttar Pradesh	47400	740	0	48346	590	0	41612	326	0	11521	43	0
West Bengal	55793	8669	30	34717	3705	17	26484	4981	65	8675	2590	22
A.N.Islands	1539	696	0	1005	334	0	557	109	0	212	29	0
Chandigarh	201	3	0	150	2	0	114	0	0	26	0	0
D & N Haveli	4940	2149	1	1778	513	0	669	90	1	215	14	0
Daman & Diu	186	33	0	91	5	0	56	4	0	28	2	0
Delhi	382	1	0	353	8	0	98	0	0	17	0	0
Lakshadweep	9	0	0	8	0	0	0	0	0	2	0	0
Poducherry	143	2	0	127	2	0	79	3	0	32	2	0
All India Total	**1067824**	**533695**	**519**	**881730**	**463846**	**440**	**1102205**	**722546**	**561**	**482378**	**340841**	**151**

Pf: Plasmodium falsiparum; Malaria caused by Pf is the most dangerous form of Malaria

Source: National Vector Borne Disease Control Programme (NVBDCP); Directorate General of Health Services, Ministry of Health & Family Welfare.

(P): Provisional, *Upto July 2015,

Details of Japanese Encephalitis(JE) and Acute Encephalitis(AES) cases and deaths from 2012													
Sl. No.	Affected States/ UTs	2012				2013				2014			
		AES Cases	Deaths	JE Cases	Deaths	AES Cases	Deaths	JE Cases	Deaths	AES Cases	Deaths	JE Cases	Deaths
1	**Andhra Pradesh**	64	0	3	0	345	3	7	3	31	0	0	0
2	**Arunachal Pradesh**	0	0	0	0	0	--	0	0	102	9	32	3
3	**Assam**	1343	229	463	100	1388	272	495	134	2194	360	761	165
4	**Bihar**	745	275	8	0	417	143	14	0	1358	355	20	2
5	**Delhi**	0	0	0	0	0	0	0	0	0	0	0	0
6	**Goa**	84	0	9	0	48	1	3	1	17	0	0	0
7	**Haryana**	5	0	3	0	2	0	2	0	6	1	5	1
8	**Jharkhand**	16	0	1	0	270	5	89	5	288	2	90	2
9	**Karnataka**	189	1	1	0	162	0	2	0	75	0	13	0
10	**Kerala**	29	6	2	0	53	6	2	0	6	2	3	2
11	**Maharashtra**	37	20	3	0	0	0	0	0	0	0	0	0
12	**Manipur**	2	0	0	0	1	0	0	0	16	0	1	0
13	**Meghalaya**	--	--	--	--	0	0	0	0	212	3	72	3
14	**Nagaland**	21	2	0	0	20	0	4	0	20	1	6	0
15	**Punjab**	0	0	0	0	0	0	0	0	2	0	0	0
16	**Tamil Nadu**	935	64	25	4	77	8	33	0	346	4	36	3
17	**Tripura**	--	--	--	--	211	0	14	0	323	0	14	0
18	**Uttarakhand**	174	2	1	0	0	0	0	0	2	0	2	0
19	**Uttar Pradesh**	3484	557	139	23	3096	609	281	47	3329	627	191	34
20	**West Bengal**	1216	100	87	13	1735	226	140	12	2385	348	415	78
21	**Telengana**	--	--	--	--	--	--	--	--	155	5	0	0

TOTAL	**8344**	**1256**	**745**	**140**	**7825**	**1273**	**1086**	**202**	**10867**	**1717**	**1661**	**293**

Source: Source: National Vector Borne Disease Control Programme (NVBDCP); Directorate General of Health Services, Ministry of Health & Family Welfare.

Kala-azar cases and Deaths in the Country since 2009

Sl. No.	Affected States/ UTs	2009		2010		2011		2012		2013		2014	
		Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths
1	**Assam**	26	0	12	0	5	0	6	0	4	0	1	0
2	**Bihar**	20519	80	23084	95	25222	76	16036	27	10730	17	15695	10
3	**Delhi #**	12	0	92	0	19	0	11	0	6	0	0	0
4	**Gujarat #**	0	0	0	0	0	0	0	0	0	0	0	0
5	**Himachal Pradesh**	0	0	6	1	1	0	0	0	0	0	0	0
6	**Jharkhand**	2875	12	4305	5	5960	3	3535	1	2515	0	937	0
7	**Madhya Pradesh**	0	0	0	0	0	0	0	0	0	0	0	0
8	**Punjab #**	0	0	1	0	0	0	0	0	0	0	0	0
9	**Sikkim**	5	0	3	0	7	0	5	0	8	0	5	0
10	**Uttarakhand**	2	0	1	0	0	0	7	1	0	0	4	0
11	**Uttar Pradesh**	17	1	14	0	11	1	5	0	11	1	11	0
12	**West Bengal**	756	0	1482	4	1962	0	995	0	595	2	668	1
TOTAL		**24212**	**93**	**29000**	**105**	**33187**	**80**	**20600**	**29**	**13869**	**20**	**17321**	**11**

Source: Source: National Vector Borne Disease Control Programme (NVBDCP); Directorate General of Health Services, Ministry of Health & Family Welfare. #:Imported

Clinically suspected Chikungunya Fever cases since 2007										
Sl. No.	**Affected States/ UTs**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013***	**2014***	**2015****
1	**Andhra Pradesh**	39	5	591	116	99	2827	4827	1359	133
2	**Assam**	--	--	0	0	0	0	742	0	0
3	**Bihar**	0	0	0	0	91	34	0	0	0
4	**Goa**	93	52	1839	1429	664	571	1049	1205	240
5	**Gujarat**	3223	303	1740	1709	1042	1317	2890	574	66
6	**Haryana**	20	35	2	26	215	9	1	3	1
7	**Jharkhand**	0	0	0	0	816	86	61	11	21
8	**Karnataka**	1705	46510	41230	8740	1941	8382	5295	6962	8023
9	**Kerala**	24052	24685	13349	1708	183	66	273	272	96
10	**Madhya Pradesh**	0	0	30	113	280	20	139	161	29
11	**Meghalaya**	0	0	0	16	168	0	0	0	0
12	**Maharashtra**	1762	853	1594	7431	5113	1544	1578	1572	55
13	**Odisha**	4065	4676	2306	544	236	129	35	10	0
14	**Punjab**	0	0	0	1	0	1	0	2	0
15	**Rajasthan**	2	3	256	1326	608	172	76	50	7
16	**Tamil Nadu**	45	46	5063	4319	4194	5018	859	543	150
17	**Telaegana**	--	--	--	--	--	--	0	1687	986
18	**Tripura**	--	--	--	--	--	--	0	34	66
19	**Uttar Pradesh**	4	11	0	5	3	13	0	4	0
20	**Uttarakhand**	0	0	0	0	18	0	0	0	0
21	**West Bengal**	19138	17898	5270	20503	4482	1381	646	1032	227
22	**A.N.Islands**	0	0	0	59	96	256	202	161	51
23	**Chandigarh**	0	0	0	0	1	0	1	0	0
24	**Delhi**	203	14	18	120	110	6	18	0	0
25	**D & N Haveli**	0	0	0	0	0	100	2	8	0
26	**Lakshadweep**	5184	0	0	0	0	0	0	0	0
27	**Poducherry**	0	0	0	11	42	45	146	399	166
TOTAL		**59535**	**95091**	**73288**	**48176**	**20402**	**15977**	**18840**	**16049**	**103117**

Source: Source: National Vector Borne Disease Control Programme (NVBDCP); Directorate General of Health Services, Ministry of Health & Family Welfare.

***Provisional till 31st December; **Provisional till 29th July 2015**

Dengue Cases and Deaths in the Country since 2011											
Sl. No.	Affected States/ UTs	2011		2012		2013		2014*		2015**	
		Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths
1	Andhra Pradesh	1209	6	2299	2	910	1	1262	5	673	0
2	Arunachal Pradesh	0	0	346	0	0	0	15695	0	473	0
3	Assam	0	0	1058	5	4526	2	85	0	22	0
4	Bihar	21	0	872	3	1246	5	297	0	10	0
5	Chhattishgarh	313	11	45	0	83	2	440	9	25	0
6	Goa	26	0	39	0	198	2	168	1	73	0
7	Gujarat	1693	9	3067	6	6272	15	2320	3	657	0
8	Haryana	267	3	768	2	1784	5	214	2	10	0
9	Himachal Pradesh	0	0	73	0	89	2	2	0	4	0
10	Jammu & Kashmir	3	0	17	1	1837	3	1	0	0	0
11	Jharkhand	36	0	42	0	161	0	36	0	7	0
12	Karnataka	405	5	3924	21	6408	12	3358	2	2298	4
13	Kerala	1304	10	4172	15	7938	29	2575	11	2101	15
14	Madhya Pradesh	50	0	239	6	1255	9	2131	13	42	0
15	Meghalaya	0	0	27	2	43	0	0	0	0	0
16	Maharashtra	1138	25	2931	59	5610	48	8573	54	601	1
17	Manipur	220	0	6	0	9	0	83	0	0	0
18	Mizoram	0	0	6	0	7	0	19	0	18	0
19	Nagaland	3	0	0	0	0	0	0	0	0	0
20	Odisha	1816	33	2255	6	7132	6	6433	9	114	0
21	Punjab	3921	33	770	9	4117	25	472	8	64	0
22	Rajasthan	1072	4	1295	10	4413	10	1243	7	105	0
23	Sikkim	2	0	2	0	38	0	5	0	0	0
24	Tamil Nadu	2501	9	12826	66	6122	0	2804	3	1795	0
25	Tripura	0	0	9	0	8	0	6	0	10	0
26	Telaegana	--	--	--	--	0	0	704	1	58	0
27	Uttar Pradesh	155	5	342	4	1414	5	200	0	31	0
28	Uttarakhand	454	5	110	2	54	0	106	0	0	0

29	**West Bengal**	510	0	6456	11	5920	47400	740	4	266	0
30	**A.N.Islands**	6	0	24	0	67	0	139	0	107	0
31	**Chandigarh**	73	0	351	2	107	0	13	0	2	0
32	**Delhi**	1131	8	2093	4	5574	6	995	3	40	0
33	**D & N Haveli**	68	0	156	1	190	0	641	1	0	0
34	**Daman & Diu**	0	0	96	0	61	0	46	0	2	0
35	**Poducherry**	463	3	3506	5	2215	0	1322	1	266	0
TOTAL		**18860**	**169**	**50222**	**242**	**75808**	**47587**	**53128**	**137**	**9874**	**25**
Source: ***Source: Source: National Vector Borne Disease Control Programme (NVBDCP); Directorate General of Health Services, Ministry of Health & Family Welfare***											
P-Provisional				***Provisional till 31st December**				****Provisional till 29th July 2015**			

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