

# The Anthropocene Dialogues on Climate Change to Human Health of *Homosapiens* in India

Siba Prasad Mishra<sup>1\*</sup>, Saswat Mishra<sup>2</sup> and Mohammad Siddique<sup>3</sup>

<sup>1</sup>Department of Civil Engineering, Centurion University of Technology and Management, Bhubaneswar, Odisha, India.

<sup>2</sup>Advance Construction Management, National Institute of Construction Management and Research, Bahadurgarh, Delhi NCR, India.

<sup>3</sup>Department of Math, Centurion University of Technology and Management, Bhubaneswar, Odisha, India.

## Authors' contributions

This work was carried out in collaboration among all authors. Author SPM designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author SM managed the literature searches and a part of analysis of the study. Author MS managed the analyses of the study. All authors read and approved the final manuscript.

## Article Information

DOI: 10.9734/CJAST/2020/v39i2430869

### Editor(s):

(1) Dr. Yahya Elshimali, Charles R. Drew University of Medicine and Science, USA.

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Complete Peer review History: <http://www.sdiarticle4.com/review-history/59471>

Review Article

**Received 13 July 2020**  
**Accepted 08 August 2020**  
**Published 19 August 2020**

## ABSTRACT

The Anthropocene has succeeded the 11700 years old Holocene epoch from 1945. Biological annihilation about 6<sup>th</sup> mass extinction from Holocene to present is well marked but less documented though the human dominance over bio-geo-hydro spheres has been established. IUCN is the footage of the floral/ faunal species from mammals to microorganisms. Many natural disasters, killer IAS and pandemic viruses are targeting human immune system. The 21<sup>st</sup> century virulent diseases are the HIV/AIDS, SARS, MERS, Swine flu. Corona viruses are not novice whereas COVID-19 viruses are mutation of old corona viruses. It is necessary to study the COVID-19 as one of the players of the 6<sup>th</sup> Mass extinction. Present work envisages the 6<sup>th</sup> mass extinction processes in India from the Holocene to present epoch. There is gradual endangering the aboriginal species, pathogens and viral species. The geospatial extinction process of 1200 years gathered from

\*Corresponding author: E-mail: 2sibamishra@gmail.com;

different sources and synchronized in the India's time frame. The present outbreak of the killer COVID-19 has triggered threat to very human existence in mid latitudes affecting 5.0 million and fatalities 325K people over 215 countries and two ships in the globe and 101 thousand confirmed cases and 3.3K people in India (till 20.05.2020).The pandemic has paralyzed the human's social, economic, political activities and deteriorated world economy since last four months. The viral invasion is geospatially delimiting the climate change, extreme events, economy, sociology and mass immunity of the vibrant urban demography.

**Keywords:** Anthropocene; COVID-19; Holocene; 6<sup>th</sup> mass extinction; IUCN; climate change; virulent.

## 1. INTRODUCTION

The earth is under abrupt and constant stress, making the life of the *Homo sapiens* under survival of the fittest and the trend is apocalyptic. The extinction of faunal diversity started sluggishly from late Pleistocene was increasing from 11.8 kyrs cal. BP (early Holocene). The human dominance over geo-bio- hydro sphere has summoned the Anthropocene epoch from the day of nuclear explosion (1945) though it started from pre-industrial revolution [1-3]. The prompted drivers for the novice epoch are human's over-exploitation of mother nature climatic changes (CC) and vector/viral diseases which are the steps to 6<sup>th</sup> mass extinction [4-9].

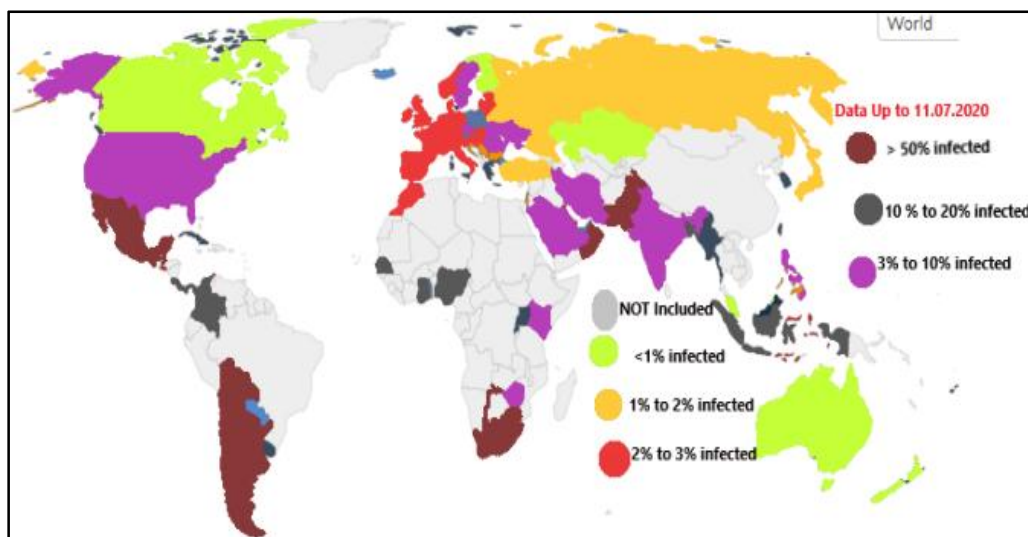
## 2. AIM OF STUDY

Modern people are the carters of present climate change from the days of Industrial revolution to the present Anthropocene. The natural extremes

like meteorological, geological and anthropogenic actions have initiated many natural disasters, and pandemic microbial species which are targeting human immune system. The 21st century virulent diseases are the HIV/AIDS, SARS, MERS, Swine flu. and COVID-19 viruses. It is necessary to study those virulent diseases (especially Covid -19) as one of the players of the 6th Mass extinction. Present work envisages the correlation between the anthropogenic/ natural activities related with ongoing 6th mass extinction in India from the Holocene to present (Fig. 1).

### 2.1 Review of Literature

Proxy records reveal that about 200000 YBP (post glacial maxima) Indian coast lines retreated ≈60-100m offshore as at present MSL. During 12700YBP, Holocene epoch brought climate changes which brought week rainfall during pre-epoch which surge up during 9000 to 6000YBP (Lake level rise, green India and cultivation). Later an arid phase occurred from



**Fig. 1.** The present extinction processes of the earth COVID-19

5000 to 3500YBP and at present the dry period is continuing with Interim Ice Age. The historical evidences arid phase coupled with vanishing of the River Saraswati, desertification of the Thar Desert, downsizing of Chilika and Koleru Lake, Southern shift of east flowing Paleo Rivers and extinction of the Indus Valley Civilization, [10-13]. The study evaluates the reports of the chronology Working paper ESA/P/WP.241 of United Nation in 2015, that nine countries such as India, Nigeria, Pakistan, Congo (Democratic Rep.), Ethiopia, Tanzania (united republic), the USA, Indonesia, and Uganda shall have demographic growth of about 50% of total population of the globe by 2050. Vectors like Covid-19, Japanese encephalitis, dengue, chikungunya, Zika, and yellow fever etc. are the viruses have catastrophe effect to Indians due to population explosion, poverty, migration, malnutrition, increased connectivity, social practices, immune deficiency, unplanned sprawl, deforestation, vectors geography, climate change and altered agri-practices, [14], [15]. WHO has reported virus, bacteria and parasites are causing infectious diseases whose 17% kills about 700K people annually. The nutrients for human health and growth are honey and ghee as per Charak Sanghita being adulterer now days, [16].

### 3. GEOSPATIAL LIFE OF HOMOSAPIENS IN ARYABARTA

The human evolution dates back to 200-100ky cal BP by mutation of Homo-erectus from Paleolithic, Mesolithic and Neo lithic. They were opulently multiplied as had rarely faced any great

mass extinction. After total extinction of the large species; Homosapiens became gradually dominating species over the earth starting from Holocene to present Anthropocene. The novice epoch; Anthropocene is hardly 75years old enough to pass through a priming period for only 50-60 years where the population growth rate reached the apex but initiated since 2000-3000years (Indus, Harappa and Mohenjo-Daro civilization in Indian subcontinent). The social, political and technological developments are reflected in Indian epics and old literatures from hunter gathers to modern man like Ramayan, Mahabharat and Kali era (Yuga concept).

The Aryans came to India for only about 6-8KYBP ('000 years before present) [17] and the demography of Indian subcontinent was only 100K people during early Holocene, [18]. Under warm and stable climate (9000YBP-7500YBP), agriculture with Barley and wheat was introduced and was in practice in NE India. The Indus Valley Civilization ran with 4 to 6mn people in India. The population of Indian subcontinent was 142 million(mn) in 1600 to 256mn in 1871 and further increased in 1900 was roughly to 294 mn, [19]. From the date of invoke of Anthropocene epoch (1945), the population has exploded from 340mn to 1378.5mn at present (Worldometer – 20<sup>th</sup> May 2020).

### 4. ANTHROPOCENE EPOCH

A debate is under progress from 2002 [20], [21], [3] about geochronological and stratigraphically shift of the earth from the Holocene to Anthropocene epoch. It is the outcrop of the

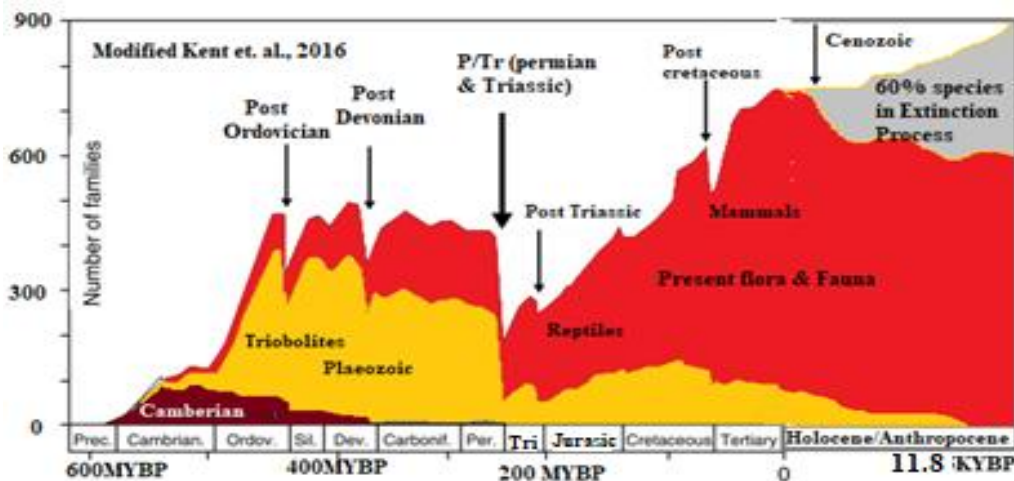


Fig. 2. Various distinction processes of the globe from 1<sup>st</sup> to present

human activities being propelled by the Industrial Revolution from mid-18<sup>th</sup> century. The propelling anthropogenic causes are by different cycles like hydrologic, carbon, nitrogen, and phosphorous etc. The 6<sup>th</sup> mass extinction has been geared from 1980FY onwards when the population growth and the increase in food production curves met. The reasons of extermination are due to meteorological extremes, geological changes and anthropogenic activities that have changed the Anthroposphere [22], [3].

#### 4.1 Geospatial Climatic Change, India

The prolonged droughts/famine created food scarcities during the years 1911,1913,1915,1918 and 1920, including death of Indian soldier's in the World War I (1914-18) There was decline of population growth of India 1901to 1921 (@5.42%). It was due to the viral diseases like H1N1 influenza, small pox (12million in 1918), Bacterial infection cholera, and vector diseases like plague, Malaria and Filarial etc.. Later there was steady rise in population in India from year1921 from 251mn to 361mn (47% rise in only 30 years) in the year 1950. It was due to less pandemics, floods, cyclonic storms and good SW-monsoon. From 1960 onwards modernization, industrialization, urbanization, and technology advancement had encouraged urban migration and population growth. Wild animals have reduced by 50% in last 50 years whereas human population has grown 200%. The statistics in India (Table 1).

#### 4.2 The CC and the Mass Death History in Anthropocene

The climate change in the Anthropocene have influenced mortality rates in tropics and sub-tropics by disturbing the natural extremes has brought changes in the spread of bacterial and vector borne diseases to viral fomite, contact, zoonotic, air/ water/ foodborne diseases which is posing together a severe extortions to food security and planetary health. The changes during Anthropocene epoch due to climate change and microbial changes are given in table, the (Table 2) indicate that the zoonotic diseases and the human are found proliferating in human through domestic, bovine, poultry, wild animals and wild birds during 21st century.

#### 4.3 Sixth Mass Extinction

The formation earth dated to 4.5billion YBP whereas in structured ecosystem the microbes

(Stomatolites) were available 3.7billion YBP in CO<sub>2</sub> atmosphere. The present photosynthetic life with O<sub>2</sub> in air was available with cyanobacteria (great oxidation event) from 2.4billion YBP. The first animal sponge was only 700million YBP whereas the *Homo sapiens* formed only during cretaceous period 65million YBP, [23]. Paleontologists, along with the evolution of life on earth have found mass extinctions on earth in different periods heavily downsizing the floral and faunal population class and size. Till date about 75% of species have missed from fossil record. Five such extinction has infringed and the sixth one in progress,[24].

The Pleistocene mega fauna extinction and the Neolithic revolt had increased the CO<sub>2</sub> and CH<sub>4</sub>emission with a drop during interglacial period during approach of Holocene epoch (~13000yrs BP). With good monsoon climate, the paradigm shift was from cattle grazing to agriculture. The Indians went through a golden period when the food production was higher than the demand. Dating to deglaciation during the LGM (Last Glacial Maximum) and later during early Holocene, the climatic chauffeurs were the changes in sun earth geometry (orbital insolation trend), solar irradiance changes, volcanic bustle, GHG gasses, LU/LC changes, [25], (Fig. 2).

#### 4.4 6<sup>th</sup> Extinction 21<sup>st</sup> Century

The IUCN, (International Union for Conservation of Nature) prepares annual comprehensive inventory of the world of species including India (MoEFCC) from 1998 onwards. They assess and count status wise seven categories of species like extinct, extinct in the wild, critically endangered, endangered, vulnerable, near threatened, least concerned and data deficient (EX, EW, CR, EN, VU, NT, LC and DD). According to IUCN red list, 51397 species in 2020, subspecies and varieties (590 numbers), Sub populations (51numbers), Amazing species (91nos), possibly extinct (481 numbers), possibly extinct in wild (24 numbers) and updating needed (13590 numbers) Table 4. IUCN has reported that 31000species are threatened extinction, 40.2% amphibians, 25% mammals, 34% conifers, 14% avifauna, 30% sharks and Rays, reef corals 33% and some selected crustaceans 27%.

#### 4.5 Drivers of 6<sup>th</sup> Mass Extinction

The major driver of 6<sup>th</sup> extinction is the increase of GHG gasses in the atmosphere as the GHG

**.Table 1. Global statistics of CC disasters with viral infections/deaths during Holocene Epoch (1mn = 10<sup>6</sup> & 1K= 10<sup>3</sup>)**

Era/period	YBP	Popul <sup>n</sup> (mn)	Climatic information/ Calamities	World	Death
Holocene	-10000	0.10	Cold glaciation(11K-8KYBP);		
Stone age	-4000	1.00	Warm climate (8K-4K) YBP,	Plague of Justinian was pandemic	
Bronze age	-2000	6.00	Warm stable climate (8K-4K)		
Iron Age	-500	25.00	Vedic Civilization (100-500BC), high Agriculture Yield.	Medieval warm period	
Mauryan	-200	42.50	Mauryan Era the golden period		
Classical era	0	60.00	Kalinai Dam & Irrigation started (1st century AD)	Antonine plague (165-180) smallpox/ measles	5mn
Early Medieval period	600	62.60	Travelling, Black death, Plague	Justinian Plague (541-542) Yersinia pestis bact. / Rats, fleas (Egypt)	30mn
	800	66.00	MSL was 2m lower than present, present climate good plant grew	Japanese smallpox 735-737 Variola virus	1mn
Late medieval era	1100	73.20		Plague (1340) spread by ships	
	1400	92.90		Black death (Bubonic plug)1347-1351; Yers-iniapestisbact./rats, fleas	200mn
	1500	99.30	Child birth, Famine, war and meteorological extremes	dysentery, diphtheria, malaria, flu, smallpox typhoid, and leprosy	
Mughal era	1600	129.20	Little Ice age, Maunder Minimum	World (Plague) 1520; Variola major	56mn
	1650	150.80		17th cent. Italian plague (1629-31) Yersinia pestis bacteria / Rats, fleas, Plague (Xenopsylla cheopis)	3mn
	1700	172.80	Urbanization started	18th century great Plague; Yersinia pestis bacteria / Rats, fleas (1665)	0.6mn
	1750	183.00	1769-70 famine in Bengal		2mn
British era	1800	190.40	Dalton minimum 1800-1820	Yellow fever1800, Cholera Pandemic 1817, 1829, 1852, 1863, 1881, 1899,	100-150K
	1870	212.00		1870-1923 Cholera-1-6; V Cholera	1mn +
	1881	232.00		3rd Plague; Yersinia pestis bact. / Rats, fleas;1885,1896 (India/ China)	12mn
	1891	244.00	Stable population, fall due to famine, Malaria,	Yellow fever (1885) Russian Flue 1889-1890; H2N2 (avian origin)	1-1.5 mn
	1921	287.22	H1N1Influenza virus and plague(1890-1901), 1901-1911 no famine, good rain	Spanish flue (Sept 1,1918 -19th Jan, 19) H1N1 virus / Pigs	40-50mn
	1931	293.55	Popul <sup>n</sup> grew (1%-1.35%), good rain, less cyclones/ calamities,	Encephalitis Lethargica	

Note: Sources are NCEI [26-30]

**Table 2. Statistics of global CC/ calamities along with viral infections and deaths during Anthropocene**

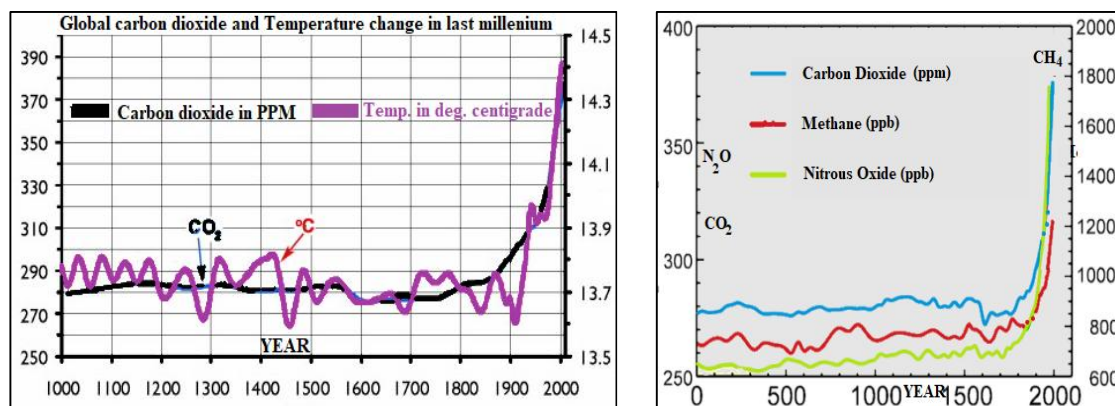
Era/period	YBP	Popul <sup>n</sup> (million)	Climatic changes/ Calamities	World	Death (M; K)			
Anthropocene era (1945 onwards)	1951	361.09	Heavy floods	1957-58 (Asian Flu); H2N2 virus	1.1mn			
	1961	439.24			1968-70Hong-Kongflue;H3N2 virus;Polio	1mn		
	1971	548.16			Mod.to Strong heat waves	1970-90 (6/1000 child)		
	1974	607.1				Small Pox Epidemic	15000	
	1981	683.33				HIV/AIDS1981conti.;Virus,Apes	25-35mn	
	1998	1016.00				Supper cyclone in East coast India		10000
	1999	1034.5						
	2000	1053.1				Dry year		
	2002	1045.85				1983-2012, Warm period	SARS2002-03;Corona	770
	2003	1108.0				Severe heat wave AP	Chikungunya;(2006) Meningo coccal, Meningitis (2005)	≈5000death
	2009	1214.3	Uttarakhand rain, ESCS Phailin	Swineflue;2009-10;H1N1virus/		200K		
	2013	1281.0		Severe cold wave, Heat wave, storm Nanuk, Hudhud, Nilofer		Ebola virus (2014-16); / Wild animals	11.3K	
	2014	1296.00			MERS /Coronavirus / Bats, camels			850
	2015	1310.0		Sev. .heatwave, Norewester, lightening, storms(Ashobaa, Megh,Komen, Chapala, Chennai				
	2016	1325.0	Sev. heat wave, 51 <sup>o</sup> C Raja sthan Roanu, Kyant & Nada,		18000 died in India			
	2017	1339.0	Heat waves, drought, Cyclones Maruta/ SCS Mora					
	2019	1353.00	VSCS Okhi					
			Storm activity in Arabiban sea aggravated than Bay of Bengal	Avian Botulism; Rajasthan	18000 birds			
	2020	≈1376.2	Pandemic virus the threats human existence World; 12869.8 <sup>Th</sup> Patients/deaths 568.3 <sup>Th</sup> people (12.07.2020)	COVID-19 (from March 2019 till date) started from Wuhan, China	India 853.2 cases/			

Note: Sources are The World Bank Group [11,17,29,30,31]

**Table 3. The five mass extinction that the earth has trespassed in geological time frame**

Extinction Number	YBP	Class lost	Species lost	Events	Major changes
6 <sup>th</sup> : Pleistocene	c-	60%		Extinction.≈ 177 species, >	Virus, bactria,
Holocenene (PH)	12000			80% mammals 1900 - 2020,	fungi, microbes
Extinction	YBP			Asia, Aust. & Africa high,	are data
(Continuing)				31000 / 51397No Species,	deficient

Note: Sources are [32-35]



**Fig. 3. (a) and (b). The trend in rise GHG gases and parallel average temperature changes of earth**

gasses like CO<sub>2</sub>, NO<sub>2</sub> and CH<sub>4</sub> which induces the rise in temperature of the atmosphere of the globe. The global warming is followed by mean sea level rise (MSLR) and loss of carbon sequestration of the sea that affect the biology of our mother earth. The climatologists have identified 2025 as one climate peak, 2042-2072 as tipping point for accelerated mass extinction escorting high temp., CH<sub>4</sub> release, and ice melt with MSLR. They will result in of flooding, climatic, geological portent, growth of microbial, bacterial, vector and virulent activities, Among the drivers like climate forcing, the actual temperature anomaly, the anthropogenic upsurge in greenhouse gasses (GHG) concentration in atmosphere, hydrosphere and geosphere with gradual change in increase in global temperature.

Anthropogenic activities like fossil fuel burning, smelter processes and deforestation have raised the concentration of CO<sub>2</sub> in the atmosphere which has exceeded the threshold of 400 ppm. The anthropogenic stresses have increased the average atmospheric temperature from 1945 at slower rate whereas from 21<sup>st</sup> century it is faster (51<sup>o</sup> C in India on 19<sup>th</sup> May, 2016 at Phalodi,

Rajasthan). The rise is very fast along with the GHG.

#### 4.6 Climatic Influence on Human Health

Appearance and proliferation of disease-causing vectors, viruses and microbes are influenced by climate changes and status of their carriers like travel, community action and migration. Vector borne diseases in India like Dengue, Malaria, and Lyme diseases are influenced by temperature, Rainfall, Relative Humidity (RH), and the type of vector, virus stages and their distribution. The air borne diseases influenza, pulmonary/tracheal diseases are dependent upon temperature, RH, the pathogen survivability transmitted by level of fomite or droplet infection. The food and water borne diseases are contaminated the level of mismanagement of wastes (solid, liquid and gaseous), Eutrophication, algal blooms, sea fishes and unprocessed raw fishes can develop faster under Temperature, precipitation (type, frequency and intensity), salinity, alkalinity and water contamination. The demography, habitation, sanitation, immunity, nourishment, tectonic, meteorological, geological and anthropogenic



stresses also plays important role in fighting the endemic or the pandemic [36] Fig. 3.

#### 4.7 Vectors/Viruses: A Part to 6<sup>th</sup> Extinction

According to report-March 2020 of WHO; 700K people die annually by 17% virus in the world. The killer Malaria (parasitic infection due to *Anopheles* mosquitoes) causes about 219mn cases in the world 400K human fatalities (mostly infants) every year. Dengue caused by *Aedes* mosquitoes transmit >3.9bn people causing 40k deaths annually. The fever Chikungunya, the Zika virus, West Nile fever, yellow fever, Japanese encephalitis, tick-borne encephalitis, COVID-19 are contact based. But apart from everything life expectancy has risen up as per World Bank report during Anthropocene (Fig. 5). The vectors and the carriers of the viral diseases during Holocene are given in Table 5. Some communicable viral diseases are also Sexually transmitted diseases (STD), venereal diseases (VD) of spreads on physical contact only. During 1580, the influenza, 1918-19 the killer H1N1 influenza pandemics (40-50mn deaths) are the examples that had reduced the population statistics of some countries. The invention of vaccine by Jenner (1796) or Louis pasture (1885), electron microscope (1930), development of the science of virology had brought revolution to the health care science.

#### 4.8 History of Viral Diseases

The social preceding of viruses datable to Neolithic period (pre-Holocene) that pronounces their power of viral infections and the catastrophic impacts are visible on flora, fauna and Human beings. The impacts were noticeable on *Homo sapiens*, plants and animals when the human race became densely populated due to industrialization, urbanization or agriculture. Viruses started to transmit fast and became either endemic or pandemic. The wild animals reduced and the bovines started carrying those viruses like poty viruses of potato plants, or rinderpest virus in bovines and the species faced distressing penalties.

#### 4.9 Viral Diseases in India

The deaths reported by government due to an endemic or pandemic outbreak are much less than the actual. The different viral diseases are Pandemic or endemic or pocket

containment. Such viral diseases are Cholera, Chikungunya, Crimean-Congo hemorrhagic fever, Hendra virus infection, Ebola virus disease, Influenza (pandemic, seasonal, zoonotic), Marburg virus disease, Lassa fever, Meningitis, Monkeypox, MERS-CoV, Nipah virus infection, coronavirus-19 (2019-nCoV), Plague, Rift Valley fever, SARS, Smallpox, Tularaemia, Yellow fever and Zika virus disease. The virus that has outbreak in India are given in (Table 6) [41] (World Health Organization 2018).

#### 4.10 Viral Diseases Eradicated/Checked in India

All new viruses mutate and change their configuration. The human and animal bodies get immune to old viruses and they become simple pathogens in long run like H1N1 (present cough and cold influenza). The two ways to face the viral diseases are either isolation (Lockouts) or vaccination. Invention of vaccines is long term processes (Few years) within which immunity developed within the body of human or animals or birds so that the virus was no longer apocalyptic. The earth has eradicated two viral diseases as ongoing process like small pox and Rinderpest. Efforts are made by doctors and health care people to eradicate or in eradication process. some parasitic and viral diseases like small pox, Malaria, Poliomyelitis, Measles, Mumps, Guinea worm disease, Lymphatic filariasis, HIV, Diarrhea, Cholera (1-6), Cysticercosis, Rubella etc. which are in control in India but need attention Table 7.

#### 4.11 Microbes of 21<sup>st</sup> Century

The microbes are of two types (bacteria single celled and viruses are smaller). Viruses can be of two types i.e. DNA or RNA viruses, subject to their use DNA or RNA to reproduce. Viruses those cause common cold, bronchiolitis, pneumonia and other pulmonary diseases are many and they can be of RNA origin and are Paramyxoviruses, Parainfluenza virus, Picorna viruses and Coxsackie virus (Echo, Rhino viruses), Ebola virus and retro or human immuno-deficiency virus causing common cold other bronchus and pulmonary diseases. Similarly, DNA group groups of viruses like Herpes Zoster, Herpes simplex, Cytomegalo, Epstein Barr, and Papilloma can cause pharyngitis, pneumonia in immune suppressed patients [43].



**Table 4. Numbers and % rise in threatened species (CR, EN and VU) reported globally from 2000 to 2020 (IUCN)**

	Total assessed 2000	Total threatened 2000	% of total	Total assessed 2020	Total threatened 2020	% of total	% rise or fall
<b>Vertebrates:</b> Mammals, Birds, Reptiles, Amphibians, Fishes	6208	3507	56.49	51993	9063	17.43	39.06
<b>Invertebrates:</b> Insects Mollusks, crustaceans, Corals, Arachnids, Velvet worms, HS crabs & others	3277	1928	58.83	23418	5333	22.77	36.06
<b>Plants:</b> Mosses, Ferns, Gymnosperms, Flowering plants, green/red alps	7022	5611	79.91	40468	16460	40.67	39.23
<b>Fungi &amp; Protists:</b> lichens, Mushrooms, Brown algae	0	0	0.00	300	174	58.00	-58.00
Total	16507	11046	66.92	116177	31030	26.71	40.21

**Table 5. The bacterias/the viruses and their vectors of the epidemics/ pandemic diseases during Holocene**

Vector	Carriers	Disease caused	Pathogen
Mosquito	Aedes	Dengue, Lymphatic filariasis, Yellow Fever, Rift Valley fever, Zika, Chikungunya,	Arbo-viruses & Parasitic
	Anopheles Culex	Malaria & Lymphatic filariasis West Nile fever (Virus), Lymphatic filariasis (parasitic), Japanese encephalitis	parasitic Virus, Parasite
Zoonotic	<b>Pet animals:</b> cats, dogs & horses	Q-fever, Jacob disease, Rabies, Bartonellosis etc.	Tuberculosis
	<b>Bovines:</b> Cattles	Q-fever, Tuberculosis, Leptospirosis, Zoonotic influenza, Brucellosis	
	Livestock: Pigs	H1N1 virus, influenza, Tuberculosis, Streptococcus, Leptospirosis, Japanese encephalitis	
	Sheeps/goats/deer	Toxoplasmosis, Q fever, Rift valley fever, Tularemia, Tuberculosis, Leptospirosis etc.	
	Poultry/fowl	Campylobacteriosis, Influenza,	
	Wild: Badger, wild bore	Tuberculosis, Streptococcosis, Toxoplasmosis	
Wild birds, waterfowl	Wild: deer, foxes, rabbits, hares,	Q fever, Anaplasmosis, tuberculosis, Tularemia, Rabies,	
	Rodents, squirrels	Leptospirosis, plague, Monkey pox	
	Wild birds, waterfowl	Influenza, Japanese encephalitis, Q-fever, West Nile fever, Chlamydia	
	Aquatic fauna	Leptospirosis	
Aquatic snails	Biomphalaria, Bulinus	Schistosomiasis (bilharziasis)	Parasite

<b>Vector</b>	<b>Carriers</b>	<b>Disease caused</b>	<b>Pathogen</b>
Blackflies	Simuliidae	Onchocerciasis (river blindness)	Parasite
Fleas		Plague (transmitted from rats to humans)	Bacteria
Lice	Simuliidae	Tungiasis	Ecto parasite
Sandflies		Typhus, yphus and louse-borne relapsing fever	Bacteria
		Louse-borne relapsing fever	Bacteria
Ticks, (Arthropods)	Ixodes, Dermacentor, Hyalomma; Arthropod-borne viruses	Leishmaniasis	Bacteria
		Sandfly fever (phlebotomus fever)	Virus
		Crimean-Congo haemorrhagic fever, Lyme disease, relapse fever, Rickett, Tick-borne encephalitis, Tularaemia	Virus
		Lyme disease, CCHF, dengue, chikungunya, Japanese encephalitis and KFD	Bacterial
		Relapsing fever (borreliosis)	Bacterial
		Rickettsial diseases (eg: spotted fever & Q fever)	Bacterial
		Tick-borne encephalitis	Virus
Triatome bugs	Phlebotomia, Triatominae	Tularaemia	Bacterial
Tsetse flies	Glossina	Chagas disease	Parasite
Contact	Adenovirus (1-47), (ABC)	Sleeping sickness (African trypanosomiasis)	Parasite
Bats/ Pengolin - aquafauna	<i>Alphavirus</i> and <i>Nairovirus</i>	Influenza	DNA genome
		Corona, SARS-COV-2002, MERS-2019, COVID-19, Hanta-CoV19, Nipah, Orthomyxovirus	RNA Virus

WHO fact sheet: Vector-borne diseases [37-40]

**Table 6. The 21<sup>st</sup> century *Homo sapiens* mass extinction due to viral diseases in India**

#	Month/Year	Name of Virus	Place India	Source	Etiology	confirmed	Death	Inference
	<b>Mar-2020</b>	<b>Corona</b>	<b>India</b>	<b>China</b>	<b>Covid-19</b>	<b>113.5 Th</b>	<b>3.46Th</b>	<b>on 21.05.2020</b>
1	MJJA-2018	Nipah Virus	Kozhikode Dist., Kerala	Pig	Contact/NIV	19	17	Zoonotic disease, acute resp. problem
2	NDJA- 2017	Zika viruS	Bapunagar, Ahmedabad	Aedes mosquito	RT-PCR	3	0	Acute Febrile Illness (AFI)
3	March 2009-15	Swine flue	Rajasthan, Delhi, Karna-taka, Maharastra, Gujarat	Pigs, birds	H1N1 virus	1469	28	Influenza
3	Mar-Oct 2006	Chikungunya/Dengu	India (AP, and Odisha)	<i>Aedes mosquito</i> <i>Arbovirus</i>	DenguVirus (Musquitoes carrier)	10575		
4	Feb-06	Avian Influenza	Navapur, Maharashtra		H5N1 infection	12	1	acute resp. problem
5	Sep-05	Japanese Encephalitis (JE)	Odisha, Bihar & UP	Culex tritaeniorhynchus/ Culex vishnui		UP-1145	UP-296	
6	May 2005	Meningococcal	Shahdara, Paharganj, Civil Lines and Central Delhi.		contact /Neisseria meningitidis serogroup A	405	48	1966, 616 cases( Delhi) and 1985, 6133 cases with 799 deaths India,
7	Nov Dec 2003	Dengue		dengue virus, sero types	haemorrhagic fever.	2185	4	
8	Apr-2003	SARS	China, Mangolia & Australia Canada (29 countries)	SARS virus	diarrhoea	7628	587	India 3461 cases with 170 deaths on 18 <sup>th</sup> only
9	Feb-2002	Pneumonic Plague	Simla H.P.	Yersinia pestis	pneumonic	16	4	
10	Aug-2001	Cholera	Odisha,	Serogroup O139 decreasing	Vibrio cholera	34111	33	

**Table 7. The eradicated and fag end of eradication of the parasites, bacteria's, viruses**

#	The infectious disease	Statistics world	Statistics India	Cause	Method eradication	Exterminated
1	Smallpox	last case 1980	World's smallpox cases in 86% of globe in 1974 but last case was reported 24 <sup>th</sup> May 1975			yes
2	<i>Rinderpest(Cattle plague)</i>	400,000 rinderpest reported/ year, deaths ≈ 200,000 milch animals eradicated. India June 1995, world in 2011				yes
3	Guinea worm disease	1986-3.5mn, 2019-54case	No cases from2000	Parasitic, Dracunculiasis	Pure Water & awareness	eradicated in India
4	Poliomielitis	2.5million in 1988 to 33 cases 2018	5child/1000 birth up to 1990	Poliovirus	Vaccination	Paralytic 2-5% in children 15-30% in adults
5	Measles/Chicken Pox (direct contact)	140k in 2017	24076 - 2019	Paramyxoviruses Measles morbilli/ Varicella zoster virus (VZV)	Vaccination, quarantine	86% by 2018
6	Mumps	5.6million 2017	45 out breaks 2016	paramyxovirus	MMR vaccine	1.5% case fatal
7	Lymphatic filariasis or Elephantiasis,	893 miln people in 49countries in 2018	31million microfilarial (mf) symp tommatic	W. bancrofti, B. malayi, B. Timori, round worms	Aedes, Culex, Anopheles, and Mansonia mosquitoes.	Preventive chemo therapy
8	Cysticercosis or Neurocysticercosis (NCC)	2.56–8.30 million	30% of endemic cases of epilepsy	Tapeworms: T.solium, T. saginata, T. asiatica	Pig vaccination	Stay in human but pig interim

Note: Sources are WHO Fact sheet-2018[42], [43]

#### **4.12 Cholera Endemic in India (1997-2006)**

Cholera outbreak in coastal districts along east coast during summer is rampant and India has faced 7 pandemic attack of V-cholera from 1817 to date. Statistics tells the numbers of cases during 1997-2006 were 37783cases/84deaths reported whereas actual cases only in Odisha were 102778cases/ 823deaths,[44], [45], has reported about annual frequency of V-cholera in India were 675188cases/ 20256 deaths. With proper vaccination and medical attendance, the cholera cases/ deaths in last decade has reduced drastically in India due to oral cholera vaccine (OCV) but its effect has still prevailing in African countries.

#### **4.13 SARS and MERS (2003-2015)**

Severe Acute Resp. Syndrome (SARS) broke in India from 17<sup>th</sup> April 2003 and remained as endemic till 14<sup>th</sup> May 2003. There were 8450 cases causing 587 deaths in 32 countries including India. The etiological agent SARS was the corona virus CoV started from province Guangdong, China (World Health Organization;[46]. Similar viruses like Middle east respiratory syndrome (MERS) virus (infected from camels) had been identified in 1366 confirmed cases with MERS-COV, causing 487 deaths, by 7/2015, [47].

#### **4.14 Dengue (2003 – 2015)**

Dengue virus (serotypes DEN-3& 2) had outbreak with 2185 confirmed patients during Oct-Nov 2003 (WHO data) but 774 deaths/ 8000 cases reported in India and the virus was controlled [48].

#### **4.15 Meningococcal Diseases (2005)**

Meningococcal meningitis, air-borne bacterial disease is highly seasonal and epidemic in sub-Saharan African continent that borne and spread during the hot, humid and dry time of the year and decay during rainy season. Meningococcal meningitis disease (1966) was an endemic in Delhi but identified as sporadic cases. 48 deaths/405 cases were reported till first week of June 2005. The Serogroup A viruses are due to house hold contacts.

#### **4.16 Swine Flu (2015)**

Swine Flu is H1N1 flu is a pandemic started in 2009 and still in surveillance in India from Mar.

2015. It is the resurgence of the infection of lungs and pharynx followed by pneumonia with plausible modalities are due to low temperature; fall in immunity and lack of vaccination and number of deaths in 2015, 2017, 2019 are 2035, 2270, 1128, and 1218respectively, [49] [50].

#### **4.17 HIV in India 2017-2020**

Patients due to Human Immuno-deficiency Virus (HIV), the RNA virus, dominated the globe and cases were 37.9 million (770K deaths) during 2018. The HIV registered statistics of India (3<sup>rd</sup> largest country) during 2017 were 2.14 million with about 69K deaths. against About 2.1 million people suffering from Acquired Immuno-deficiency Syndrome (AIDS) by (HIV) as per statistics India 2017(UN AIDS data 2018). The epidemic is concentrated among a particular pocket of populations, including male sex workers (MSM of population 265740), female sex workers (FSW of population 776237) as they are at high-risk with HIV intrusions in India (2018-19). The HIV infected people are freely given medical assistance (antiretroviral) in Govt. hospitals. India has 7660619 migrants and 2603528 HIV patients have been identified during 2018-19 reported by the nodal body for National AIDS control Organization (NACO), the MoHFW[51].

#### **4.18 Present CORONA Virus 2019**

The severe acute respiratory illness (SARI), later called as COVID 19 started from Wuhan state (containment area), China, from 31st Dec 2019[47]. Later COVID-19 became an emerging, rapidly spreading apocalyptic viral (droplet & fomite) infection by fag end of Feb 2020, and as on date has wide spread over 210 countries, territories, including two ships and in full swing. The core countries affected areas USA, Brazil, India, Russia, Peru are the most pretentious mid latitudes countries as on 12<sup>th</sup> July 2020. The tropics and the polar areas are affected but least. Urbanization, high population density, especially low income group areas and migrant people settlements are the most virulent places of viral attack (Fig. 4).

Since the outbreak of COVID-19 Pandemic new lexicons like Quarantine, Lock down, herd Immunity, self- isolation and social distancing etc. type words commonly used. *The global statistics states about 16.64mn reported cases in 210 countries with 656.5K mortalities in the world from COVID-19 pandemic outburst till 28<sup>th</sup>, July, 2020 at 0141 UMT whereas in India it is ≈1.5mn*

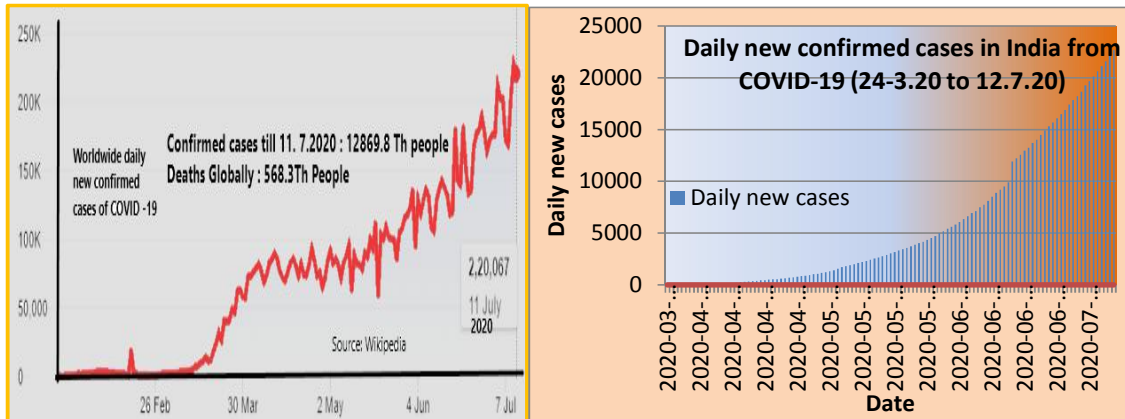


Fig. 4. The trend of COVID – 19 transmission in the globe and the 2<sup>nd</sup> Largest populated state India



Fig. 5. The impact of pandemic COVID -19 intensity map on 12.7.20

cases with deaths  $\approx 33.5^{th}$  at the same period (Worldo meter). In India the death toll is 879.5K people infected and 23.2k people died from the pandemic by 12.07.2020. The number of cases and deaths are rapidly increasing. The end to the current suffering and post corona impacts when thought is shattering the human existence (Fig. 5).

**5. DISCUSSION**

The emerging and mutation of viruses offers threats to very human existence under exploiting

population growth in urbans [52]. Unplanned and inefficient control strategies under local, national and international level shall invite catastrophe to human and the animal kingdom. The genetic diversity and their impact on geo-bio system during Anthropocene epoch demands national/ international level researches on the geospatial genetic diversity, viruses and their mutation under climatic changes. More emphasis should be laid upon multifaceted scientific studies like Nano technology, Molecular biology, chemistry of life, bio-informatics, gene applications, data

mining and analysis, etc. as we are encountering the sixth extinction process within the golden spike period of Anthropocene epoch.

A CORONA virus has initiated a cold war which my outburst very soon. The lock downs have degraded the national economy, fall in GDP, increased domestic violence, making people dependent on government assistances, labor thrift. Impact of COVID 19 may modify the world's order. The top order protagonist countries are in apprehension of change of their order as the ground politics like supremacy over technology and innovation (belt and road initiative to China-2025, technological and ideological authority, suppression of facts against the present apex, the USA.

The top order countries in USA, Europe, Middle East and South East Asia are fighting for their existence to survive against existence at the cost of health care vulnerabilities and uncertainties, climatic changes, industrial jeopardy, economy degradation arising of lock down/ lock out, spoiled social and political relation to fight the Corona disease. New viruses and wide spread of viruses may affect the human life [15]. The death toll is mounting not month wise even but date wise. The date of flattening of death curve is not yet speculated and achieving asymptotic condition is considered to be in the horizon. In such a strategy, it is apprehended that the corona virus is accelerating the progressive sixth mass extinction.

## 6. CONCLUSION

Since the sixth extinction is under process with the key drivers like anthropogenic stresses, over exploitation of natural resources, ecological squalor, economy collapse, socio political turmoil, poverty and human conflict. With 7.3 billion people in the present globe, it is difficult to have social distancing to maintain modern economic, social and political activities. The modern people are coping with the ecological consequences of the mass extinction we have started many years ago during Holocene Epoch in India. These consequences are more reflected in the current Coronavirus disease (COVID-19) outbreak, as well as many other diseases and hence it is the time to change our relation with the environment.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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