



Professor Dr. Mohammad Abdur Rob¹
Department of Geography and Environment
Dhaka University, Bangladesh

Natural Disasters in Indian Ocean region and its Impact on Socio-Economy of the Countries

Introduction

The Countries and Regions in and around the Indian Ocean constitute around 50 states with a total land-area of 33 million sq. km. These states and regions accommodate about 2.6 billion or 39% of the global population. The Indian Ocean occupies about 20% of the total ocean area of the world which covers a total of 73,427,000 sq .km of the globe stretching from East-Africa to west-Australia- a distance of about 6,400 km or 4000 miles from west to east and from south Asia to Antarctica in North-South Orientation. The Oceanic islands and littoral countries are thickly populated and at the same time these maritime regions are greatly vulnerable to different types of natural disasters with varied nature and differentiated effects. The states located along rim land areas of the countries in Eastern Africa, Southern Asia and South Asia. Asia is mostly poor and developing nations. Natural disaster under the group of climatologically (Cyclones, droughts), geological and tectonically (Earth Quakes and Tsunami's) Hydrological (Floods, tidal Surges, etc) origins are very common and recovering phenomena in the region. Although geographically the Indian Ocean region does not exhibit a coherent homogenous regional characteristics yet most of these littoral or oceanic areas experience a general tropical warm humid and semi-arid climatic condition and essentially due to these differentiated geographical peculiarities the whole of the Indian Ocean Region can be divided into several sub-regions with their diversified and complex regional geographical ,climatologically, geological, hydrological and the resultant vivid biological or ecological sub-systems. Geologically and tectonically this region is one of the most unstable regions of the earth. Different tectonically plates have been actively moving beneath the sub-surface sports of different areas of this region. As a result these areas very frequently experience great earth quakes of huge magnitudes and very often these trigger great tsunamis or marine surges. Among the climatic catastrophic – tropical cyclones very often ravage the coastal parts of India, Bangladesh, Myanmar, Thailand, Sumatra, Eastern Africa, Arabian peninsula or Sri Lanka and Pakistan Recurring floods and cyclonic coastal surges are very common phenomena along the coastal states of the Indian Ocean Region. From The historical parts up to the very recent period's great earth quakes, huge floods, devastating, Tsunamis and prolonged draughts, famines, stormed, river-bank erosion etc numerous natural disasters wave enormously been causing tremendous loss to the life, property and environmental settings of the I O R. As a chain reaction of these disasters poverty, political unrest famine, diseases and epidemics and many other socio-economic vices have seriously been decaying and degrading the inhabitants of the most of the states of the region.

¹ Professor Dr M A Rob is currently the Vice Chancellor of the Manarat International University. He is an eminent academican of the Department of Geography and Environment of Dhaka University. He acquired M. Phil. and Ph. D. from Aligarh Muslim University. He has authored ten books so far and has a number of articles on environment and geo-politics published in various national and international journals. Dr. Rob has served as the Chairman of the Bangladesh Red Crescent Society.

Indian Ocean Region (IOR): Geography and Oceanography

The Indian Ocean Region (IOR) covers about one seventh of the earth's surface. Indian Ocean is deepest in the Java Trench with a maximum depth of 24,442 ft. The Red Sea, Arabian Sea, Persian Gulf, Andaman Sea, Bay of Bengal and the Great Australian Bight are IOR's noteworthy marginal seas. The Indian Ocean is connected with the Pacific Ocean by straits through the Malay Archipelago and between Australia and Antarctica; and with the Atlantic Ocean by the expanse between Africa and Antarctica and by the Suez Canal. The continental shelf of the Indian Ocean is narrow. Madagascar and Sri Lanka, the largest islands in the Ocean, are structurally parts of the continents as are Socotra, the Andaman Islands, and the Nicobar Island; the Seychelles and the Kerguelen Island are exposed tops of submerged ridges. The Laccadives, the Maldives and the Reunion are high volcanic islands.

The average depth of the Indian Ocean is 3,500 meters. The main oceanic body of the IOR is divided into three major sections- the African, Antardis and Australasian- by an elongated Ocean ridge with an average 3000m, elevations.

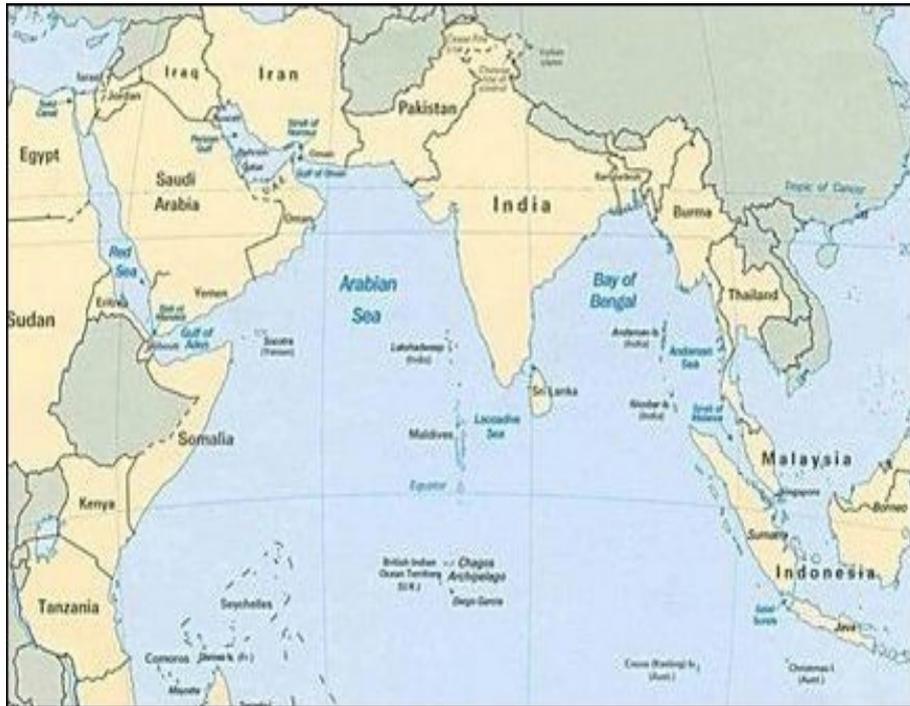
The Indian Ocean receives the discharges of the Ganges, Brahmaputra, Indus, Tigris-Euphrates Irrawady and Zambezi (Africa) rivers. The South west monsoon winds related to the oceanic northern regular drift –draws huge moisture from the Indian Ocean and causes copious downpours in India, Pakistan, Bangladesh, Myanmar, Thailand, Nepal and others northern IORs.

The IOR bears great geo-political, geo-economical, geo-strategically as well as geo-environmental significance and importance. In this Oceanic Region eight peripheral sub-systems (Indian Ocean sub-systems) have developed. These are : i) South-east Asian, ii) South Asian, iii) Central Asian, iv) Persian Gulf, v) Horn of Africa vi) Eastern African vii) Southern African, viii) S.W Indian Ocean Island and ix) Southern Island and EEZ. Besides its huge population and resource potentials the IOR is very important because of its strategic location in the supply route of the Gulf oil and the extremely significant global shipping routes including its strategically “Choke points” (viz. the Hormuz str., the Bab-al – mandab str. The Malacca str. Etc). Along with these strategically and economical importance- the IOR is the same important because of its environmental (i.e. climatologically and geological) significance. World's most severe tropical cyclones are generated in the northern part of the ocean near the Andaman Sea. The north and north Asian coastal and inland flanks of the IOR experience world heaviest rainfalls and associated inundations. Sometimes, some of those turn into the most disasters deluges of the globe, Moreover, the IOR is also the most vulnerable to the great tsunami.

Types, Nature and Impact of Natural Disasters in Indian Ocean Region

The IOR is sometimes called the “World's Hazard belt” which is subject floods, droughts, cyclones, earthquakes, tidal surges, land slides, Tsunamis etc. According to an ESCAP report (1995) around 50% of the global natural disasters occurring in this region and these hazards incorporate mostly the climatogenic and seismogenic (tectonically) disasters.

Figure-1 Indian Ocean Region in Map (IOR)



The major natural disasters of the IOR can be categorized into the following types:

Weather and hydrology related disasters

These include hydrological and meteorological hazards like tropical cyclones, tornados, severe storms and floods, coastal or marine inundations and surges.

Geological or tectonical disasters

The IOR is highly vulnerable to these types of natural disasters that are linked to the geological mechanisms of the Indian oceanic sub-surface tectonics where three major crystal plates, i.e. The African, The Indian and The Antarctic Plates converge in the IOR. Along the convergence margins of these plates volcanic eruptions, earthquakes and Tsunamis are occurred and very often these geological phenomena terms into most devastating natural disasters in IOR.

Natural Disasters Originated from Global Climatic Change

These are the very recent natural dangers that owe this genesis to the global climatic change. These involve the unusual change in the global temperature, depletion in the ozone layers at the atmosphere, meltation of the polar and alpine glaciers and rise of the sea levels. The same climatic anomalies affect the EL Nino Southern Oscillation that results in a lowering of mean sea level in the east of the region (viz. IOR), of the monsoon raises in south Asia and prolonged droughts in S.E. Asia and Australia. Out of numerous natural hazards of the IOR

floods, cyclones, Tsunamis and earthquake are most devastating and deadly disasters. Cyclones are the strong maritime storms that are called typhoon in pacific region and hurricane in Caribians. The cyclones are originated in the southern Bay of Bengal of IOR driving April to December and moves to the northern Bay where the land falls occur on the eastern coast of India, southern coast of Bangladesh and western coast of Myanmar of Chittagong (Bangladesh). These occur during the changing monsoon winds. These tropical storms some times strike the coasts of Arabian Sea to North West of the IOR. Most of the tropical cyclones of the northern IOR are informs for their velocity, ferocity and distinctive nature. These cyclones are usually accompanied by extensive rainfall, huge inundations and devastation tidal surges that may cause immense loss to life and property in the affected areas. The IOR- especially the northern coastal periphery of the IOR has had some most devastating tropical storms- the brief accounts of which are stated below:

- 1584** Backergonj Cyclone killed around 200,000 people.
 - 1737** Calcutta cyclone, Caused death and distraction around Calcutta, India
 - 1839** Indian Cyclone-caused a massive storm surge hi Coringa, India on November 25 killed 300,000 people
 - 1864** Calcutta cyclone, killed around 60,000 people in Calcutta, India
 - 1876** Great Baekergonj Cyclone hit two meghna river delta area of India, the storm surge killed 100,000 and desire after the storm killed another 100,000.
 - 1882** Great Bombay cyclone killed around 200,000 people in Bombay, India.
 - 1897** Chittagong Cyclone, killed around 175,000 in chittagong, Bangladesh
 - 1942** Bengal Cyclone hit near the India/Bangladesh Border, resulting in around 40,000 fatalities.
 - 1970** Bhola cyclone, killed between 3 lac to 5 lac people in east Pakistan (non Bangladesh).
 - 1971** Orissa cyclone, killed around 10,000 people in Cuttack, India
 - 1988** Cyclone 04B on November 26 the cyclone hit the Sundarbans, past of Bangladesh, Heavy storm surge killed 2000 people. In addition the storm caused **1000** fatalities in Malaysia, Thailand and western Indonesia.
 - 1991** Bangladesh cyclone killed 138,000 people in the chittagong region of Bangladesh.
 - 1999** Orissa Cyclone, 10,000 people in the Orissa state of India
 - 2007** Cyclone, Sidr, struck Bangladesh on 15 November has killed at least 35,000 people. Enormous loss to the cattle, crops, and homesteads occurred by this deadly storm. A Bangladesh government report (April 2008) revealed that a total damage of Tk. 79,904,000,000 was calculated against the loss of the Sidr.
 - 2008** Cyclone Nargis, Struck the Irrawaddy Delta in Burmaa killing over 145,000 people and devastating the countries former capital and largest city.
- The cyclone Aila struck the southern Bangladesh in December 2009. Although the loss to life was least in Aila still huge damage to crops and other properties due to this storm was colossal.

Table-1 : Most Active Seasons in terms of Cyclone of Indian Ocean Region:

Year	Total Storms	Tropical Depressions (Nos)	Tropical Storms (Nos)	Tropical Cyclones
1992	13	2	8	3
1987	8	0	8	0
1996	8	0	4	4
1998	8	0	3	5
2005	8	1	6	1

Tsunami

The floor of the Indian Ocean very frequently triggers some terrible marine waves towards the coasts of the IOR. These swiftly moving marine surges are called Tsunamis. These are deadly maritime disasters that are originated under the seabed and are associated with the sea-bed earth-quakes; Tsunamis may cause enormous destruction in the coastal areas. On 26 December, 2004 a devastating tsunami occurred near the island of Sumatra (north-west), Indonesia in the eastern IOR. The magnitude of earth-quack which causes this Tsunami was about 8.0 on Richter scale. A total of 11 IOR states (coastal regions) were seriously affected due to this tsunami and around 300,000 persons were killed. Along in Indonesia more than 100,000 people were perished. In the events of normal tsunami the water charges/waves travel the coast in a tremendous halo city of about 300 to 1000 km. per hour. The surges rise up to 10 to 15 meters above the normal tidal rises in the coastal areas. The loss of lives and property is unbelievable. An early warning system with regional cooperation an effective trained well equipped rescue and relief contingents with well coordinated efforts can may at least some effective role in the events of such catastrophical maritime coastal disasters. In Bangladesh and its neighboring countries the Red Cross and Red Crescent Society can play a very vital and effective role in all these natural disasters.

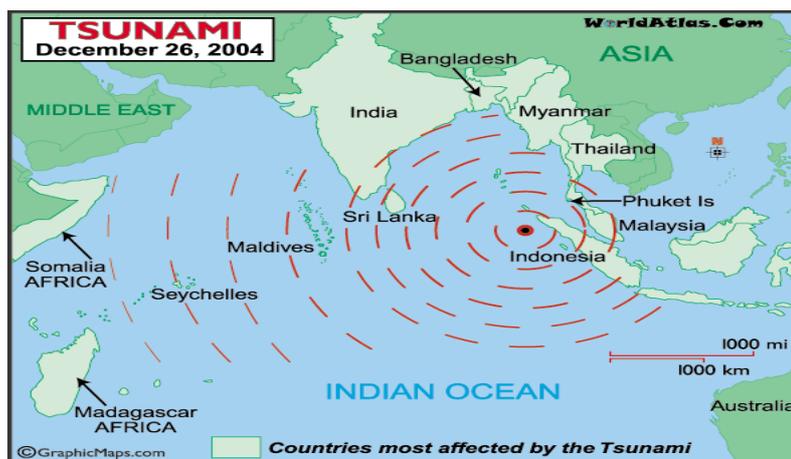


Figure-2 Indian Ocean Tsunami Map(26 December 2004)

Global Warming and Climate Change

According to the IPCC Report of 2007

- Global average surface temperature has increased 0.6 C+ 0.20 C since the late 19th century and it increased at a rate of 0.17 C per decade in the last 30 years. And this global warming has been considered as the most dangerous natural disaster (considered partially with anthropogenic) in the coming decades for the globe. Along with the numerous deltas and low lying coastal plains and islands the IOR margins have greatly been threatened by a probable danger of global climatic change and its resultant rise of sea-levels.
- Most of the warming observed over the last 50 years attributable to the human activities, in particular emissions of the greenhouse gas CO₂
- If greenhouse gas emission continues, the climate models predict the earth's temperature will continue to rise, reaching 1.4 C to 5.8 C by the year 2100.

Almost all climate scientists agree with the past point, but other two points –the cause of global warming and model prediction of future temperature trend – are points of great disagreement.

Other effects of global warming include

- A sea level rise of 9-88 centimeter by the end of the 21st century due to thermal expansion of the Oceans melting of polar ice caps and glaciers.
- Submergence of costal lowlands.
- Increased frequency and intensity of tropical cyclones.
- Increased several weather activities.

Changes in atmospheric CO₂ concentration

It is estimated that atmospheric CO₂ concentration before the Industrial Revolution was 285-290 parts per million (ppm), which has been increasing since then. Measurement taken at the Mauna Loa Observatory in Hawaii shows that atmospheric CO₂ has increased from 310 ppm in 1957 to 385 ppm in 2008

According to the IPCC reports, if the trend continues, the atmospheric CO₂ concentration may reach 450 ppm by 2050 to give the proper perspective, present day atmospheric CO₂ value of 385 ppm is nothing but 0.0385 percent of the atmosphere by volume.

It is clear that fossil fuel burning (603 BMT per Year) accounts for only 3.03 percent of total supply of CO₂ from the surface to the atmosphere, and the rest of the atmospheric CO₂ Come from natural sources (Nearly 97 percent).

It was shown earlier that water vapor is the single largest greenhouse gas in the atmosphere (2 percent by volume) and CO₂ is the far distant second green house gas (0.0385 percent). It was also shown earlier that only 3 percent of the CO₂ come from fossil fuel burning.

Among the top three greenhouse gases , water vapor absorbs in a much wider band of long wave radiation (4-8 micrometer bands) and CO₂ absorbs in a narrow band (13 -16 micrometer band) and Ozone (O₃) absorbs in a much smaller narrow band (9-10 micrometer).

Because water vapor is the most dominant greenhouse gas in the atmosphere because it absorbs in a much wider wave length band water vapor has the single largest greenhouse effect among all the greenhouse gases. Now let us examine the partial contribution of various greenhouse gases to the greenhouse effect.

Professor S Fred Singer (atmosphere Physicist and emeritus Professor of Environmental Science, University of Virginia, Former director of the US weather Satellite service) performed calculations of this effect.

His work entitled: "Water vapor ruled the greenhouse system: A closer look at the numbers" was published in 2001, and is available on the internet. His calculations show that water vapor alone contributes 95 percent to the greenhouse effect, and all other greenhouse gases together contribute 5 percent to the greenhouse effect. His calculation further show that the man made portion of CO₂ contributes only 0.117 percent to the greenhouse effect.

This suggests a gross discrepancy between the scientific basis of the partial contributions of anthropogenic CO₂ to the greenhouse effect and IPCC claims of global warning cost by anthropogenic carbon dioxide.

Conclusion

From the foregoing studies and discussions it is evident that the IOR-countries are seriously vulnerable to different types of natural disasters. The coastal or the rim-countries of the Indian Ocean like India, Bangladesh, Indonesia, Sri Lanka, Myanmar, Thailand, Malaysia, Malagasy Rep. Kenya, Mozambique, S. Africa, Maldives, Pakistan, Oman, etc have been seriously experiencing one or another kind of natural disasters. Floods of longer duration and frequent occurrence have caused great losses to the life and property in Pakistan, Bangladesh, India and Nepal. Earthquakes of greater magnitudes (7+) have ravaged Iran, Afghanistan, India, Pakistan, Indonesia, several times in the last decades. Devastating Tsunamis, triggered, from the Indian Ocean bed have destroyed some coastal areas of India, Sumatra (Indonesia), Malaysia, Thailand, Sri Lanka, and some East African states only in 2004. Not only these, Cyclones, Tornadoes, landslides and huge forest-fires are very common and devastating natural hazards of the IOR. Only in 2007-2008 and 2009 three mega cyclones, occurred in the northern Bay of Bengal of the IOR and caused death and distraction to huge life and property in Bangladesh, Myanmar, and India (i.e. Sidr, Nargis and Aila respectively).

In the recent years the frequency, magnitude and severity of occurrence of these natural disasters are increasing alarmingly. Particularly the disasters of climatic type's viz. Cyclones, storms, floods, and draughts etc. are in the increase. Scientists are of the opinion that these

are the fallout of the looming global climatic change in the IOR. In all consideration this can be envisaged that the natural disasters both of climatogenic and siesmogenetic categories have been appeared as great treats to the inhabitants of the IOR in the recent times. The foregoing studies reveal that most of the devastating natural disasters in the IOR are linked with either of the climatologically, hydrological, oceanographically or geological mechanisms of the Indian Ocean Region. At the same time, it has been observed that the scientific early warning system or disaster forecasting can save huge life and property from these disasters especially cyclones, floods, or even Tsunamis can be detected and forecasted. Through earlier and successful dissemination of information and scientific data among the vulnerable areas nations can be of immense help since these natural disasters particularly their occurrence does not follow any political boundary. This is why Regional co-operational approach in Combating natural disaster (RCACND) should be followed in formulating disaster management policy among the states of the IOR. In order to enrich the serious gap in the data and information related problems an international IOR disaster management and research institute having sub regional units for the entire local and national needs should be established. Asian sub regional Groups like SAARC, ASEAN, Gulf Cooperation, Arab League and East African Nation should have their joint disaster management and research centers of their own. In order to combat the looking threats of the Global Warming and threats of rising sea lands in the coastal low-laying nation like Maldives, Bangladesh, India and some others seriously vulnerable states-“IOR climate change research and management committee” or similar institute/organization should be formulated to face the challenges of climatic change and associated disasters in the regions in and around Indian Ocean. Several experts committees including seismic and Geological aspects, climatologically and atmospheric aspects and hydrological and oceanographically problems of the IOR can also be formulated by the experts from the states of the IOR.