Pollution and Community Health Effects
2023 Volume 2, Issue 1
DOI: 10.59657/2993-5776.brs.23.005

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Cyclone a Natural Calamity- Impact and Management

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Abstract

The cyclone is one of the most frequently occurring natural disaster in all tropical countries that interrupts the socio-economic development. In India, the rate of cyclone occurrence has increased by almost 30%. The main factor responsible for formation of cyclone is carioles force. On average 1-2 tropical cyclones form over the Arabian Sea each year, and few of these storms are intense enough to be classified as very severe or super cyclonic storms. The reason why the Arabian Sea has more cyclones is due to increasing sea surface temperatures and global warming. The naming of cyclones is done to make it easy for people to remember it and spread the information further. The various types of cyclones include tropical cyclone, extra-tropical cyclone, hurricane, typhoon, tornado, willy-willy, east coast lows and Bourjos. There are terrible impacts of cyclones on human health, human psychology and physical property.

Keywords: natural disaster; cyclone; tropical cyclone; global warming

Introduction

A natural disaster is a disaster with links to natural hazards. A natural disaster can cause loss of life or damage property, and typically leaves economic damage in its wake. The severity of the damage depends on the affected population's resilience and on the infrastructure available [1]. Examples of natural hazards include: avalanche, coastal flooding, cold wave, drought, earthquake, hail, heat wave, hurricane (tropical cyclone), ice storm, landslide, lightning, riverine flooding, strong wind, tornado, typhoon, tsunami, volcanic activity, wildfire, winter weather. A disaster is a result of a natural or human-made hazard impacting a vulnerable community. Human choices and activities like architecture, [2] fire, resource management and climate change [3] potentially play a role in causing natural disasters. In fact, the term natural disaster has been called a misnomer already in 1976.

The rapid growth of the world's population and its increased concentration often in hazardous environments has escalated both the frequency and severity of disasters. Extreme climates (such as those in the Tropics) and unstable landforms, coupled with deforestation, unplanned growth proliferation and non-engineered constructions create more vulnerable interfaces of populated areas with disaster-prone natural spaces. Developing countries which suffer from chronic natural disasters, often have ineffective communication systems combined with insufficient support for disaster prevention and management [4].

An adverse event will not rise to the level of a disaster if it occurs in an area without a vulnerable population [5, 6]. Once a vulnerable population has experienced a disaster, the community can take many years to repair and that repair period can lead to further vulnerability.

Cyclone

In meteorology [7], a cyclone is a large air mass that rotates around a strong center of low atmospheric pressure, counterclockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere as viewed from above (opposite to an anticyclone). [8] Cyclones are characterized by inward-spiraling winds that rotate about a zone of low pressure. The largest low-pressure systems are polar vortices and extratropical cyclones of the largest scale (the synoptic scale). Warm-core cyclones such as tropical cyclones and subtropical cyclones also lie within the synoptic scale. Mesocyclones, tornadoes, and dust devils lie within the smaller mesoscale. Upper-level cyclones can exist without the presence of a surface low, and can pinch off from the base of the tropical upper tropospheric trough during the summer months in the Northern Hemisphere. Cyclones have also been seen on extraterrestrial planets, such as Mars, Jupiter, and Neptune [9]. Cyclogenesis is the process of cyclone formation and intensification. Extratropical cyclones begin as waves in large regions of enhanced mid-latitude temperature contrasts called baroclinic zones. These zones contract and form weather fronts as the cyclonic circulation closes and intensifies.

Tropical cyclogenesis describes the process of development of tropical cyclones. Tropical cyclones form due to latent heat driven by significant thunderstorm activity, and are warm core. Mesocyclones form as warm core cyclones over land, and can lead to tornado formation [10] Waterspouts can also form from mesocyclones, but more often develop from environments of high instability and low vertical wind shear. In the Atlantic and the northeastern Pacific oceans, a tropical cyclone is generally referred to as a hurricane (from the name of the ancient Central American deity of wind, Huracan), in the Indian and south Pacific oceans it is called a cyclone, and in the northwestern Pacific it is called a typhoon.

There are six main requirements for tropical cyclogenesis:

- sufficiently warm sea surface temperatures,
- atmospheric instability,
- high humidity in the lower to middle levels of the troposphere,
- enough Coriolis force to develop a low-pressure center,
- a preexisting low-level focus or disturbance,
- low vertical wind shear.

Types of Cyclones

Tropical cyclones

Tropical cyclone is in general a cyclone formed in the tropical areas. Typically, these areas are near the equator, including the East Pacific Ocean, Atlantic Ocean, Caribbean and Gulf of Mexico. However, the word “tropical” does not refer to the place of formation, and it actually refers to the structure of a cyclone. Tropical Cyclones develop over very warm tropical waters where the sea surface temperature is greater than 26°C. They have relatively long-life cycles and severe tropical cyclones can produce significant property damage with wind speeds over 180km/h near the center, heavy rainfall and coastal inundation through storm surge.

Hurricane

Hurricane is a tropical cyclone located in the north Atlantic, eastern north Pacific and central north Pacific, eastern south Pacific. A hurricane [10] is a cyclone with winds exceeding 74 miles per hour.

Typhoon

Typhoon is a tropical cyclone located in the western north Pacific basin. Among tropical cyclones in the world, the typhoon is the most frequent and the strongest tropical cyclone.

Willy-Willy

Willy-Willy is often introduced as the name of a tropical cyclone around Australia [11], but it seems that it actually means something like a dust devil, and has little relationship with a tropical cy-clone.

Tornado

The tornado and tropical cyclone share the same feature as the low-pressure vortex of atmosphere, but other features, such as formation, structure, scale and duration, are totally different. A tornado [12] is created from thunderstorms and the wind tunnel is much narrower. In some cases, however, a tropical cyclone spawns a tornado due to the severe weather and produces irregularly strong winds beyond expectation.

Extra-tropical cyclones

Extra-tropical cyclone literally means a cyclone outside of the tropical areas. The fundamental difference between a tropical cyclone and this type is that the former consists of warm air only, while the latter consists of both cold air and warm air. This difference also leads to the different source of energy for intensification.

Cyclone in Sagar

Cyclonic Storm Sagar was the strongest tropical cyclone to make landfall in Somalia and Somaliland in recorded history until Gati in 2020, and the first named cyclone of the 2018 North Indian Ocean cyclone season. Forming on May 16 east of the Guardafui Channel, Sagar intensified into a cyclonic storm on the next day, as it gradually organized. The storm turned to the west-southwest and traversed the entirety of the Gulf of Aden, making landfall over Somaliland on May 19, farther west than any other storm on record in the North Indian Ocean. Sagar weakened into a remnant low on May 20.

The storm first affected Yemen, brushing the coast with heavy rainfall and gusty winds. In Somalia, Sagar dropped a years' worth of rainfall, or around 200 mm (7.9 in). The rains caused deadly flash flooding that washed away bridges, homes, and thousands of farm animals. Damage in the country reached US$30 million. Sagar's rainfall extended into eastern Ethiopia, damaging schools and houses, and causing a landslide that killed 23 people.

Cyclone Biporjoy

Extremely Severe Cyclonic Storm Biparjoy was a powerful tropical cyclone that formed over the east-central Arabian Sea [13]. The third depression and the

second cyclonic storm of the 2023 North Indian Ocean cyclone season, Biparjoy originated from a depression that was first noted by the India Meteorological Department (IMD) on 6 June, before intensifying into a cyclonic storm. The cyclone steadily weakened due to deep flaring convection. Biporjoy accelerated northeastward, strengthening to a Category 3-equivalent tropical cyclone and an extremely severe cyclonic storm. The cyclone made landfall in Naliya, India on June 16. Biporjoy was downgraded to a depression, and further into a well-marked low-pressure area late on 19 June. Biporjoy means 'calamity' in Bengali language.

On June 12, the IMD issued alerts to local authorities in Gujarat, encouraging them to prepare for possible evacuations. Residents in coastal areas were warned to stay indoors as the storm approached. Gujarat's government responded by dispatching national and state disaster response teams to the affected areas.

Biporjoy reached its peak intensity as an extremely severe cyclonic storm, with maximum 3-minute sustained winds of 165 km/h (105 mph). The shear decreased and convective organization and areal extent increased. Banding features are becoming increasingly evident in satellite images along the southern periphery. Biporjoy gradually weakened with convective banding over the northern semicircle. The structure of the cyclone quickly deteriorated as convection became asymmetric. Biporjoy made landfall on June 16 near Naliya, India, with sustained winds of 95 km/h (60 mph). Shortly after the landfall, the JTWC discontinued warnings on the system. The cyclone weakened into a depression. The depression was later marked as a well-marked low-pressure area by the IMD on June 19, prompting the discontinuation of advisories on the system.

Impacts Of Cyclones

Physical impact

The loss of property from tropical cyclones has increased substantially over recent years. Strong winds caused by tropical cyclones heavily damage infrastructure and buildings. High buildings are vulnerable to winds caused by hurricanes, especially as wind speeds tend to increase with height. Wind can disrupt telephone lines, antennae and satellite disks. High voltage wires can be damaged by wind, causing power cuts. Winds can cause splitting and falling of trees. A storm surge following from cyclones can lead to loss of life through drowning, inundation of low-lying coastal areas, erosion of coastline, loss of soil fertility due to intrusion by ocean saltwater and damage to buildings and transport networks.

Impact on population

Loss of lives from tropical cyclones has significantly decreased over recent years, primarily due to improvement in early warning systems, emergency preparedness and building of storms shelters. Prominent causes of death and injury are electrocutions from downed power lines, flying debris and motor vehicle fatalities.

Outbreaks of infectious diseases following tropical cyclones are rare. There has been find an increase in respiratory infections after the cyclones. Water, sanitation and health are major issues after cyclones and floods. Studies show the risks of disease are greatest where there is overcrowding and where standards of water and sanitation have declined. This often happens in situations of massive population displacement away from the flooded area and prolonged stay in flood shelters.

Psychological consequences

Behavioral health effects are among the most long-term and debilitating outcomes of tropical cyclones. Some persons experience persistent distress, post-traumatic stress disorder (PTSD), major depression, or other psychiatric outcomes. An elevated prevalence of PTSD was specifically apparent in hurricane survivors in developing nations.

Effect on property and human life

Tropical cyclones have caused significant destruction and loss of human life, resulting in about 2 million deaths since the 19th century. Tropical cyclones significantly interrupt infrastructure, leading to power outages, bridge and road destruction, and the hampering of reconstruction efforts. Winds and water from storms can damage or destroy homes, buildings, and other manmade structures [14]. Tropical cyclones destroy agriculture, kill livestock, and prevent access to marketplaces for both buyers and sellers; both of these result in financial losses.

Environmental Effects

Tropical cyclones also help maintain the global heat balance by moving warm, moist tropical air to the middle latitudes and polar regions, and by regulating the thermohaline circulation through upwelling. The storm surge and winds of hurricanes may be destructive to human-made structures, but they also stir up the waters of coastal estuaries, which are typically important fish breeding locales [15] Ecosystems, such as saltmarshes and Mangrove forests, can be severely damaged or destroyed by tropical cyclones, which erode land and

destroy vegetation. Tropical cyclones can cause oil spills by damaging or destroying pipelines and storage facilities. Waterways have become contaminated with toxic levels of metals such as nickel, chromium, and mercury during tropical cyclones.

Global warming

In common usage, climate change describes global warming—the ongoing increase in global average temperature—and its effects on Earth's climate system. The current rise in global average temperature is more rapid than previous changes, and is primarily caused by humans burning fossil fuels. Fossil fuel use, deforestation, and some agricultural and industrial practices increase greenhouse gases, notably carbon dioxide and methane. Greenhouse gases absorb some of the heat that the Earth radiates after it warms from sunlight. Larger amounts of these gases trap more heat in Earth's lower atmosphere, causing global warming.

Attribution of recent temperature rise

Attribution of recent climate change shows that the main driver is elevated greenhouse gases, with aerosols having a dampening effect.

Greenhouse gases

Greenhouse gases are transparent to sunlight, and thus allow it to pass through the atmosphere to heat the Earth's surface. The Earth radiates it as heat, and greenhouse gases absorb a portion of it. This absorption slows the rate at which heat escapes into space, trapping heat near the Earth's surface and warming it over time. Human activity since the Industrial Revolution, mainly extracting and burning fossil fuels (coal, oil, and natural gas), has increased the amount of greenhouse gases in the atmosphere, resulting in a radiative imbalance. In 2019, the concentrations of CO_2 and methane had increased by about 48% and 160%, respectively, since 1750.

Global anthropogenic greenhouse gas emissions in 2019 were equivalent to 59 billion tons of CO_2. Of these emissions, 75% was CO_2, 18% was methane, 4% was nitrous oxide, and 2% was fluorinated gases.CO_2 emissions primarily come from burning fossil fuels to provide energy for transport, manufacturing, heating, and electricity. Additional CO_2 emissions come from deforestation and industrial processes, which include the CO_2 released by the chemical reactions. Methane emissions come from livestock, manure, rice cultivation, landfills, wastewater, and coal mining, as well as oil and gas extraction. Nitrous oxide emissions largely come from the microbial decomposition of fertilizers.

Aerosols and clouds

Air pollution, in the form of aerosols, affects the climate on a large scale. Aerosol's scatter and absorb solar radiation. From 1961 to 1990, a gradual reduction in the amount of sunlight reaching the Earth's surface was observed. This phenomenon is popularly known as global dimming, and is attributed to aerosols produced by dust, pollution and combustion of biofuels and fossil fuels. Globally, aerosols have been declining since 1990 due to pollution controls, meaning that they no longer mask greenhouse gas warming as much. Aerosols also have indirect effects on the Earth's radiation budget. Sulfate aerosols act as cloud condensation nuclei and lead to clouds that have more and smaller cloud droplets.

Land surface changes

Humans change the Earth's surface mainly to create more agricultural land. Today, agriculture takes up 34% of Earth's land area, while 26% is forests, and 30% is uninhabitable (glaciers, deserts, etc.). The amount of forested land continues to decrease, which is the main land use change that causes global warming.

Solar and volcanic activity

Explosive volcanic eruptions represent the largest natural forcing over the industrial era. In the industrial era, volcanic activity has had negligible impacts on global temperature trends. Present-day volcanic CO_2 emissions are equivalent to less than 1% of current anthropogenic CO_2 emissions.

Livelihoods

Economic damages due to climate change may be severe and there is a chance of disastrous consequences. Inequalities based on wealth and social status have worsened due to climate change [16]. Indigenous people, who are subsistent on their land and ecosystems, will face endangerment to their wellness and lifestyles due to climate change.

Conclusion

Cyclone is a weather phenomenon that always has had a tremendous impact on humanity since time immemorial. Furthermore, the cyclone can certainly be dangerous for humanity as they can bring widespread destruction to humanity. Most noteworthy, it is a weather system that we would just have to live with and cope with. With the development in science and technology the forecasting regarding the duration, intensity and reach of cyclone is becoming quite

accurate and it is proving to be beneficial in terms of effective management preventing the heavy damages and losses.

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Cite this article: D.K. Awasthi, Chand S. (2023). Cyclone a Natural Calamity- Impact and Management. *Pollution and Community Health Effects*, BRS Publishers. 2(1); DOI: 10.59657/2993-5776.brs.23.005

Article History: **Received:** June 16, 2023 | **Accepted:** July 04, 2023 | **Published:** July 10, 2023