International Journal of Ecology and Environmental Sciences
www.ecologyjournal.in
Online ISSN: 2664-7133; Print ISSN: 2664-7125; Impact Factor: RJIF 5.28
Received: 01-06-2020; Accepted: 15-06-2020; ; Published: 02-07-2020
Volume 2; Issue 3; 2020; Page No. 13-18

Life history of a super cyclone with weather phenomena: A case study of Amphan

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Abstract
Amphan was a coastline tropical cyclone that caused widespread damage in East coast mainly West Bengal and Odisha along with Bangladesh. This is the first super cyclone to form in the Bay of Bengal after the 1999 super cyclone that hit Odisha. Its powerful destruction capacity was severe impact upon society and ecology, mainly in West Bengal after landfall in May 20th of 2020. This paper is based on secondary data which mainly focuses on naming, origin, stages of evolution and characteristics of Amphan.

Keywords: Um-pun, forecasting, intensification, dissipation, destruction, coastline, landfall

1. Introduction
Amphan, the biggest natural calamity to ever hit different districts of West Bengal, Odisha and Bangladesh on May 20, 2020.Amphan are intensified by warm surface temperature across water bodies. Hazards associated with Tropical Cyclones (TCs) are long duration rotatory high velocity winds, very heavy rain and storm tide (M. Mohapatra). Generally West Bengal, Orissa, Andhra Pradesh, Andaman and Nicobar are mostly affected states by TCs. The main cyclonic season occurs during May to June and October to November. These powerful storms are causing heavy damage in impoverished nations that can least afford to bear the costs. Tropical cyclones are like giant engines that use warm, moist air as fuel. It has long term and short-term effect on ecology.

2. Affected Region
The areas are affected by Amphan included parts of Andaman and Nicobar Island, Gangetic coast of West Bengal, Odisha coast, Pondicherry, Tamil Nadu and Andhra Pradesh. But these are specific as well as more intense along coastal part of Odisha, South Bengal and Bangladesh. (Fig 1).

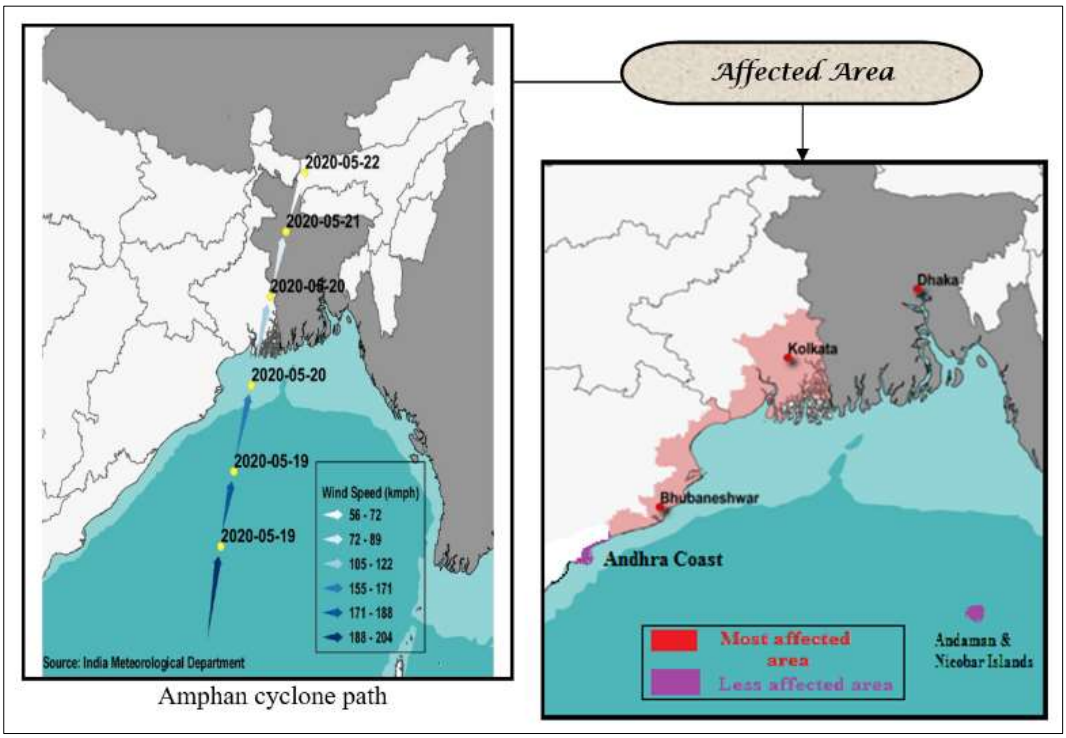


Fig 1: Amphan Cyclone Affected Region

3. Objectives

- Identify the naming of cyclone.
- Find out the origin, stages of evolution and path of Amphan Cyclone.
- Identify the weather phenomena of Amphan cyclone.

4. Methodology

This paper is mainly based on secondary information considering journals, newspaper, books as well as image and Station Model analysis. Photography techniques are also used to analyze the different objectives.

5. Naming

"Amphan", pronounced as "Um-pun", means sky. The name was given by Thailand in 2004, years ago.

The name comes from a list by a grouping of countries, World Meteorological Organization/United Nations Economic and Social Commission for Asia and the Pacific or WMO/ESCAP. The panel, which includes India, Bangladesh, Myanmar, Pakistan, the Maldives, Oman, Sri Lanka and Thailand, names cyclones in the region. "Amphan" was the last name on the current list before a new one starts.

List of tropical cyclone names adopted by WMO/ESCAP Panel Member Countries in September, 2004
(Names which have been utilised till December 2019 are marked in Red)

WMO/ESCAP Panel Member countries	Column one		Column two		Column three		Column four	
	Names	Pron'	Names	Pron'	Names	Pron'	Names	Pron'
Bangladesh	Onil	Onil	Ogni	Og-ni	Nisha	Ni-sha	Giri	Gi-ri
India	Agni	Ag'ni	Akash	Aakaa'sh	Bijli	Bij'li	Jal	Jal
Maldives	Hibaru	--	Gonu	--	Aila	--	Keila	--
Myanmar	Pyarr	Pyarr	Yemyin	Ye-myin	Phyan	Phyan	Thane	Thane
Oman	Baaz	Ba-az	Sidr	Sidr'	Ward	War'd	Murjan	Mur'jaan
Pakistan	Fanoos	Fanoos	Nargis	Nar gis	Laila	Lai la	Nilam	Ni lam
Sri Lanka	Mala	--	Rashmi	Rash'mi	Bandu	--	Viyaru	--
Thailand	Mukda	Muuk-dar	Khai Muk	Ki-muuk	Phet	Pet	Phailin	Pi-lin
WMO/ESCAP Panel Member countries	Column five		Column six		Column seven		Column eight	
	Names	Pron'	Names	Pron'	Names	Pron'	Names	Pron'
Bangladesh	Helen	Helen	Chapala	Cho-po-la	Ockhi	Ok-khi	Fani	Foni
India	Lehar	Le'har	Megh	Me'gh	Sagar	Saa'gar	Vayu	Vaa'yu
Maldives	Madi	--	Roanu	--	Mekunu	--	Hikaa	--
Myanmar	Nanauk	Na-nauk	Kyant	Kyant	Daye	Da-ye	Kyarr	Kyarr
Oman	Hudhud	Hud'hud	Nada	N'nada	Luban	L'luban	Maha	M'maha
Pakistan	Nilofar	Ni lofar	Vardah	Var dah	Titli	Titli	Bulbul	Bul bul
Sri Lanka	Ashobaa	Ashobaa	Maarutha	Maarutha	Gaja	Gaja	Pawan	Pavan
Thailand	Komen	Goh-men	Mora	Moh-rar	*Phethai*	Pay-ti	Amphan	Um-pun

6. Origin of Amphan Cyclone

The first tropical cyclone of the 2020 North Indian Ocean cyclone season, Amphan originated from a low-pressure area persisting a couple hundred miles (300 km) east of Colombo, Srilanka, on 13 May 2020. Tracking northeastward, the disturbance organized over exceptionally warm sea surface temperatures; the Joint Typhoon Warning Center (JTWC) upgraded the system to a tropical depression on 15 May while the Indian Meteorological Department (IMD) followed suit the following day. On 17 May, Amphan underwent rapid intensification and became an extremely severe cyclonic storm within 12 hours.

On 18 May, at approximately 12:00 UTC, Amphan reached its peak intensity with 3-minute sustained wind speeds of 240 km/h (150 mph), 1-minute sustained wind speeds of 260 km/h (160 mph), and a minimum central barometric pressure of 920 mbar (27.32 in Hg). The storm began an eye wall replacement cycle shortly after it reached its peak intensity, but the continued effects of dry air and wind shear disrupted this process and caused Amphan to gradually weaken as it paralleled the eastern coastline of India. On 20 May, between 10:00 and 11:00 UTC, the cyclone made landfall in West Bengal. At the time, the JTWC estimated Amphan's 1-minute sustained winds to be 155 km/h (100 mph). Amphan rapidly weakened once inland and dissipated shortly thereafter.

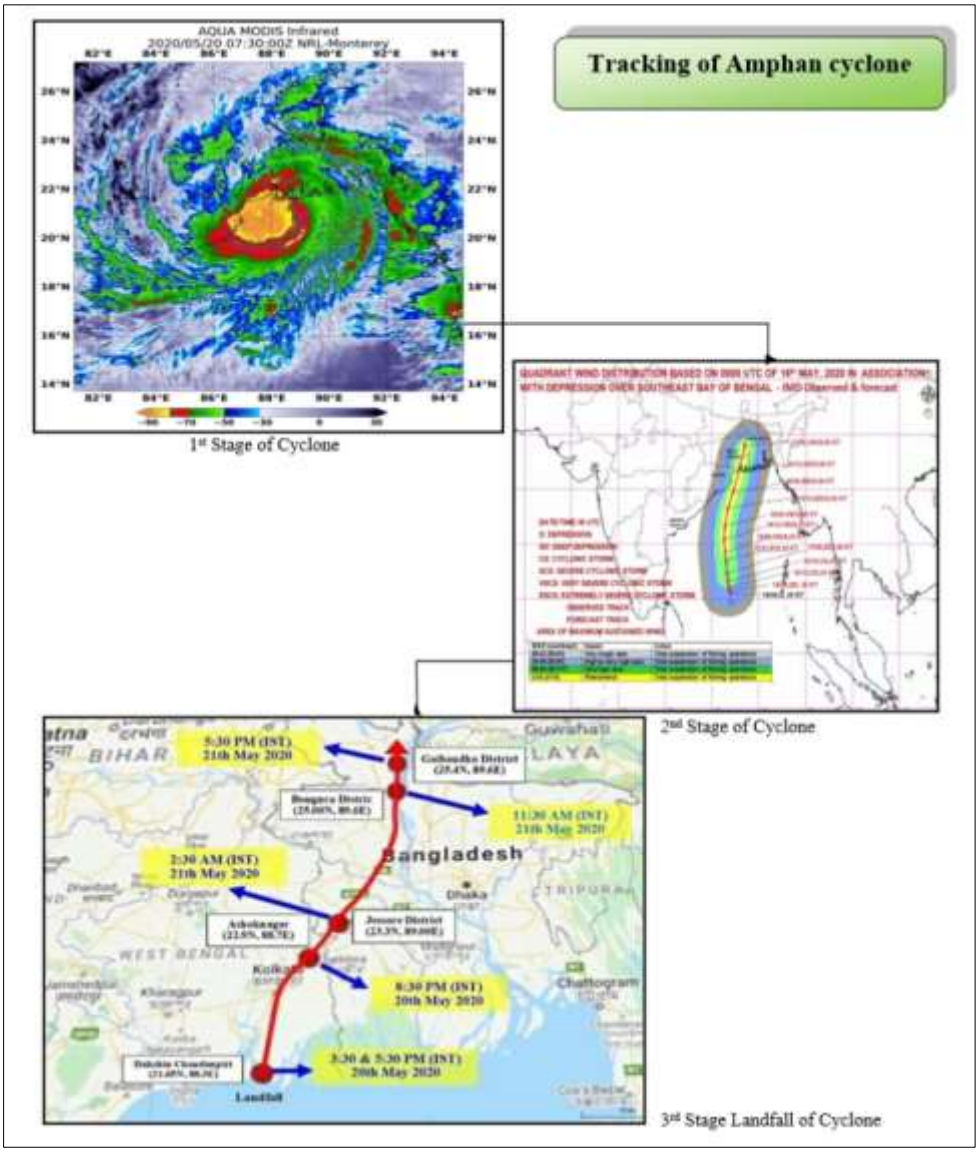


Fig 2: Tracking of Amphan Cyclone in India

7. Stages of Evolution

The Super Cyclone Amphan made landfall in West Bengal on Wednesday evening, sweeping through the southern Bengal districts, claiming tens of lives and damaging several cores of property. The storm is the most intense cyclone over the Bay of Bengal since the 1999 Odisha cyclone. Weather experts' state that the circulation system of a cyclone goes through a series of stages in which it gradually intensifies to a mature cyclone. The cyclones are only formed over the warm ocean water near the equator. These are mainly classified into three stages—namely, formation, intensification, and dissipation. The damage to life and property from a cyclone depends upon its evolution over these three stages.

Stage 1: Formation

The necessary condition for the formation of any cyclone is a warm ocean surface, with a sea surface temperature above 26.5 degree Celsius. The formation of the cyclone starts when the warm, moist air over the ocean rises in an upward direction from the near-surface. Thereby, the air gradually moves up and goes away from the ocean surface. As the warm air rises, it creates an area of lower air pressure below.

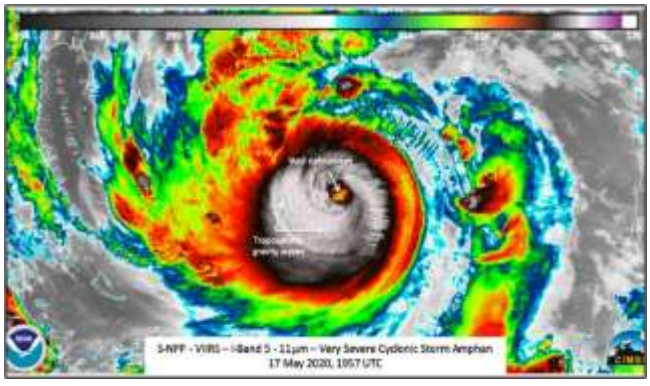


Fig 3: Formation of Eye of Cyclone

As air gradually warms it expands, and increases the frequency of winds. This air contains a huge amount of moisture—evaporated from the ocean's surface. It rises to form huge clouds.

The rotation of the Earth causes the moisture-laden winds to swirl clockwise in the southern hemisphere and anti-clockwise in the northern hemisphere.

Stage 2: Intensification

For the intensification of the cyclone, it is necessary for the exterior temperature to be cooler as it helps the warm air to continue rising at the centre of the circulation. The whirling continues, indicating the intensity of the storm, until when the surrounding air becomes cool.

Gradually the wind spins above the surface and ocean heat causes the formation of a system of clouds.

Experts suggest, if the external air is relatively humid, the circulation is more likely to intensify, as the moisture also feeds the system. In addition, for the tropical storm to intensify, it is important that the wind speed must change a little with respect to the height above the surface of the ocean.

Fig 4: Intensification of Cyclone

With the continuous whirling, a storm eye is formed at the centre of the ocean. This is also when the maximum wind speed exceeds the limit of 119 km (74 miles) per hour, required for the system to be declared as a cyclonic storm. The storm continues to feed on the ocean's heat to intensify into a super cyclonic storm, as it happened in the case of Cyclone Amphan.

Stage 3: Dissipating Stage

The decay starts when the system enters land or an oceanic region where SST is lower than 26°C.Over land the moisture supply is drastically curtailed, cutting off the energy input and also there is dissipating increased frictional drag. The wind decreases the cyclone fills up and weakness through the rainfall may persist for a day or two more.

Like an Amphan cyclones happens when it is not able to extract enough heat from the warm ocean water. This can happen when the storm crosses over to land or a cooler ocean belt. As the heat and moisture feeding the system are cut-off, the cyclone intensity is reduced. Therefore, the understanding the time duration that a storm spends on warm ocean surface, helps forecasters to predict the intensity of the storm.

Fig 5: Dissipation of Cyclone

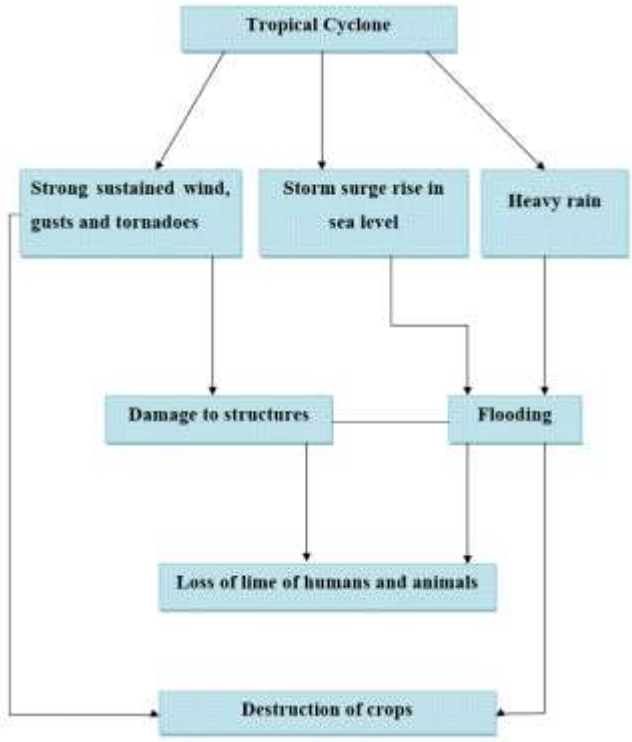


Fig 6: The potential major impacts of a tropical cyclone upon crossing the coast (landfall)

8. Characteristics

Amphan is a super tropical cyclone that originated from the Bay of Bengal in May 2020. It is considered the first super cyclonic storm in the Bay of Bengal since the 1999 Odisha cyclone. It is a part of the North Indian Ocean Cyclone Season. The Indian states of West Bengal and Odisha, and the country of Bangladesh are

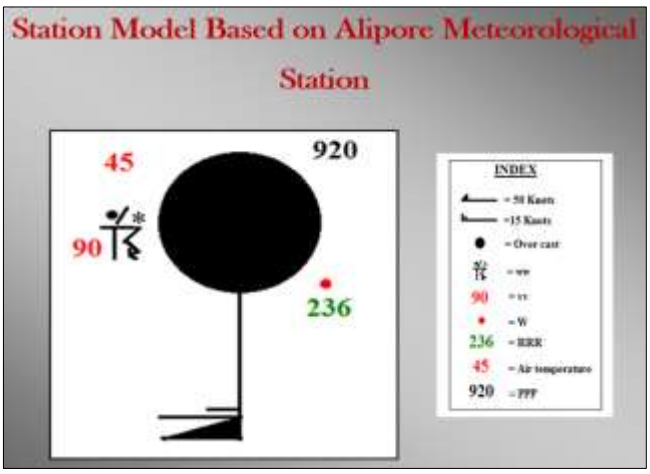
speculated to be hit by Amphan as a 'very severe cyclonic storm.'

1. Thailand has given the name of the cyclone – Amphan, which is pronounced as 'UM-PUN'.
2. Amphan formed over the Bay of Bengal as a tropical cyclone and later intensified into a 'Very Severe Cyclonic Storm' (VSCS) to 'Extreme Severe Cyclonic Storm (ESCS)'.
3. It makes landfall between Digha (West Bengal) and Hathiya islands (Bangladesh) on May 20.
4. The regions of East Midnapore, North and South 24 Parganas, Howrah, Hooghly, and West Midnapore are speculated to be affected by the heavy rainfall.
5. North Odisha Coast is said to face the maximum impact after Amphan makes landfall with the wind speed of 110-120 mph.
6. The range of wind speed of Amphan is speculated to reach up to 230-265 mph before it weakens in intensity.
7. The broad storm was characterized by a cloud shield extending more than 1,110 km (690 mi) and a sharply-outlined 10 nautical mile-wide eye.
8. The IMD weather monitoring station at Alipur in Kolkata recorded exceptionally high rainfall of 236mm over the last 24 hours from 20th May morning to 21st May morning.
9. Less atmospheric aerosol may have identified Cyclone Amphan (Prof. Simon Wang, Utah State University).
10. Doppler Weather Radar (DWR) at Visakhapatnam (Andhra Pradesh) is used to track the cyclone Amphan.
11. After the Phailin cyclone that had hit the Bengal-Odisha coast in 2013, Amphan is the strongest tropical cyclone to hit the coast.
12. The trajectory of Amphan is towards West Bengal and Bangladesh and it is speculated to make landfall as a severe storm at:

- West Bengal – Sagar Island
- Bangladesh – Hatiya Island

13. National Disaster Response Force (NDRF) is a specialized authority constituted under the Disaster Management Act 2005. It is monitoring Amphan with the parallel monitoring by:

- National Crisis Monitoring Committee (Constituted by the Government of India, to meet the exigencies of natural calamities.)
- Cabinet Committee on Security (CCS)
- Indian Meteorological Committee (IMD)



Weather condition during Amphan

1. **Barometric Pressure (PPP)** = 920mb
2. **Direction of wind (dd)** = South
3. **Velocity of wind (ff)** = 65 Knots *****
4. **Air Temperature (TT)** = 45°C
5. **Present weather (ww)** = 97 (Heavy thunderstorm with rain)
6. **Past weather (W)** = 6 (Rain)
7. **Amount of rainfall with mm (RRR)** = 235.5 mm to 236.5 mm
8. **Relative Humidity (UU)** = 96%
9. **Height of Wave (Hw)** = 5 meters
10. **Nature of sea condition** = Very Rough
11. **Horizontal visibility (VV)** = Very Poor (90)

*The air is filled with foam and spray. Sea completely white driving spray. Visibility seriously affects (Thunderstorm).

9. Conclusion

The trail of death and devastation that cyclone Amphan has left in West Bengal. The impact has been catastrophic event with reliable forecasts of its movement since May 16 and the preparatory moves by National and State Disasters Response Force units. While the battle against the virus may yet be won sooner or later India must strength its response capabilities for a never-ending cycle of storm along its coastline. Cyclone Amphan given the worsening climate crisis, this entire tale of devastation may be repeated later this year or next year. There are many questions about planning, adaptation and resilience that need to be addressed right now, but such questions should be asked all the time, not just after a disaster.

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