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## Tropical Cyclones and Their Impact on Agriculture

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### Abstract

Tropical cyclones are predominant extreme weather events occurring most often across the Bay of Bengal, Arabian Sea, and the Indian Ocean. When these cyclones hit land, they demolish everything, causing floods, starvations, and fatalities. As a result of these cyclones, the coastal regions have faced numerous challenges over time. Despite their unpredictability, forecast techniques have made it possible to predict their occurrence time and range, which is very important in order to make the necessary preparations to face the monster. Farmers are used to depending on technologies that provide advice and projections to save them from the tedious work of farming; after all, agriculture field deals with all types of weather. In this regard, the present paper focuses on detailed information and a general understanding of cyclones, the distinction between cyclones and depressions, cyclone formation, its course, various categories into which these cyclones are divided, their impact in various ways, particularly on agriculture, and finally the remedies and crop-wise advisories to be followed during cyclone forecast to minimize agricultural losses.

### 1. Introduction

In recent times, there has been an increase in the frequency of cyclonic events in tropical regions across the world (Kamaljit et al., 2021). This has led to significant losses of people and animal life, destruction of infrastructure, and massive agricultural losses. Records indicate that between 1951 and 1990, India was struck by 91 cyclones. Furthermore, from 1991 to 2000, there were sixteen storms, thirteen cyclones from 2001 to 2010, and twenty-four cyclones from 2011 to 2020. According to a recent study, between 1982 and 2019, the frequency of cyclones in the Arabian Sea increased by 52% compared to the previous two decades, and the number of very severe cyclones increased by 150% (Nair et al., 2018; Simpkins, G., 2021). Since the middle of the 20th century, there has been a significant increase in the frequency of extremely powerful cyclonic storms during the post-monsoon season (1951-2018) (Deshpande et al., 2021). On average, there were more powerful cyclones every ten years between 2000 and 2018. Because

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the agricultural sector is particularly exposed to cyclones and their consequences on food security and the economy, researchers and farmers are becoming increasingly interested in these aspects of cyclones and their genesis.

### 1.1. Cyclone and depression

The word Cyclone is derived from the Greek word “Cyclos” meaning the coils of a snake. It was coined by Henry Paddington because the tropical storms in the Bay of Bengal and the Arabian Sea appear like coiled serpents of the sea. The term “cyclone” refers to a storm or system of winds that revolves around the centre of low atmospheric pressure, moves forward at a rate of 20 to 30 miles  $\text{h}^{-1}$ , or 30 to 50  $\text{km h}^{-1}$  and frequently associated with heavy rain. The first phase of a cyclone is called a “Depression,” which is characterized by a low-pressure area and thunderstorms that generate a 39 miles  $\text{h}^{-1}$  circular wind flow. “Cyclone,” an amplified version of depression, has cyclonic winds with gusts between 39- and 73-miles  $\text{h}^{-1}$ . While the cyclone is tremendously harmful to life and the economy, the depression is somewhat less harmful.

## 2. Cyclogenesis

It is the development or intensification of cyclonic circulation in the atmosphere that is in a low-pressure area. Among the various processes that trigger cyclogenesis (Figure 1), the following weather conditions are necessary for cyclone formation in tropical regions (Kotal et al., 2009, DeMaria et al., 2001, Brian et al., 2020).

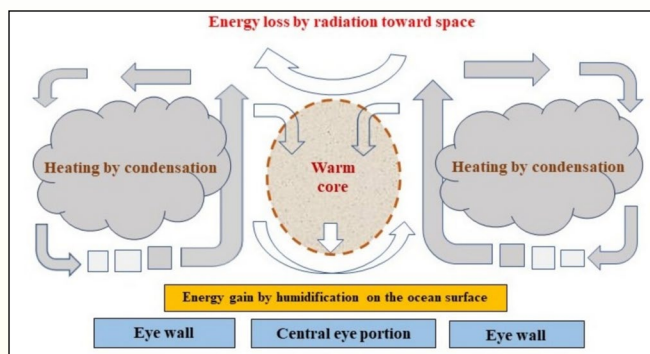


Figure 1: The processes for tropical cyclone formation

- Sufficiently warm sea surface temperatures
- Atmospheric instability
- High humidity in the lower to middle levels of the troposphere
- Low-level relative vorticity

- Enough Coriolis force to sustain a low-pressure centre
- A pre-existing low-level focus or disturbance
- Low vertical wind shear

According to Smith et al. (2021), there are three stages, in which low-pressure depression transforms into a cyclone (Figure 2).

- Initial developmental stage
- Mature tropical cyclonic stage and
- Modification and decay stage

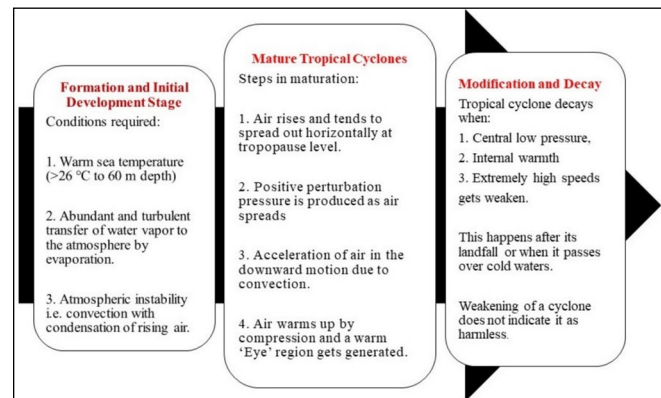


Figure 2: The development phases of tropical cyclones

## 3. Structure of Cyclone

### 3.1. Eye

The storm's centre is known as the eye. This region is around 30 km from the centre of the of the storm. It has three basic shapes viz., circular, concentric and elliptical. It is a peaceful place all over. Winds slow down and everything seems to have cleared up when the eye passes over a region (Davis, 2003; Wang and Wu, 2004). The period that follows the eye of the storm, however, typically causes the most damage; this is known as the “calm before the storm.”

### 3.2. The eyewall

The strongest portion of a cyclone is located here. Very high winds can be found within the eyewall, which can harm both people and property. It is a ring of thunderstorms, and variations in the eyewall or eye can influence how intense the storm is.

### 3.3. Rain bands

These are a cyclone's outer regions when abrupt downpours occur. There may also be voids between rain bands where neither wind nor rain falls (Figure 3).



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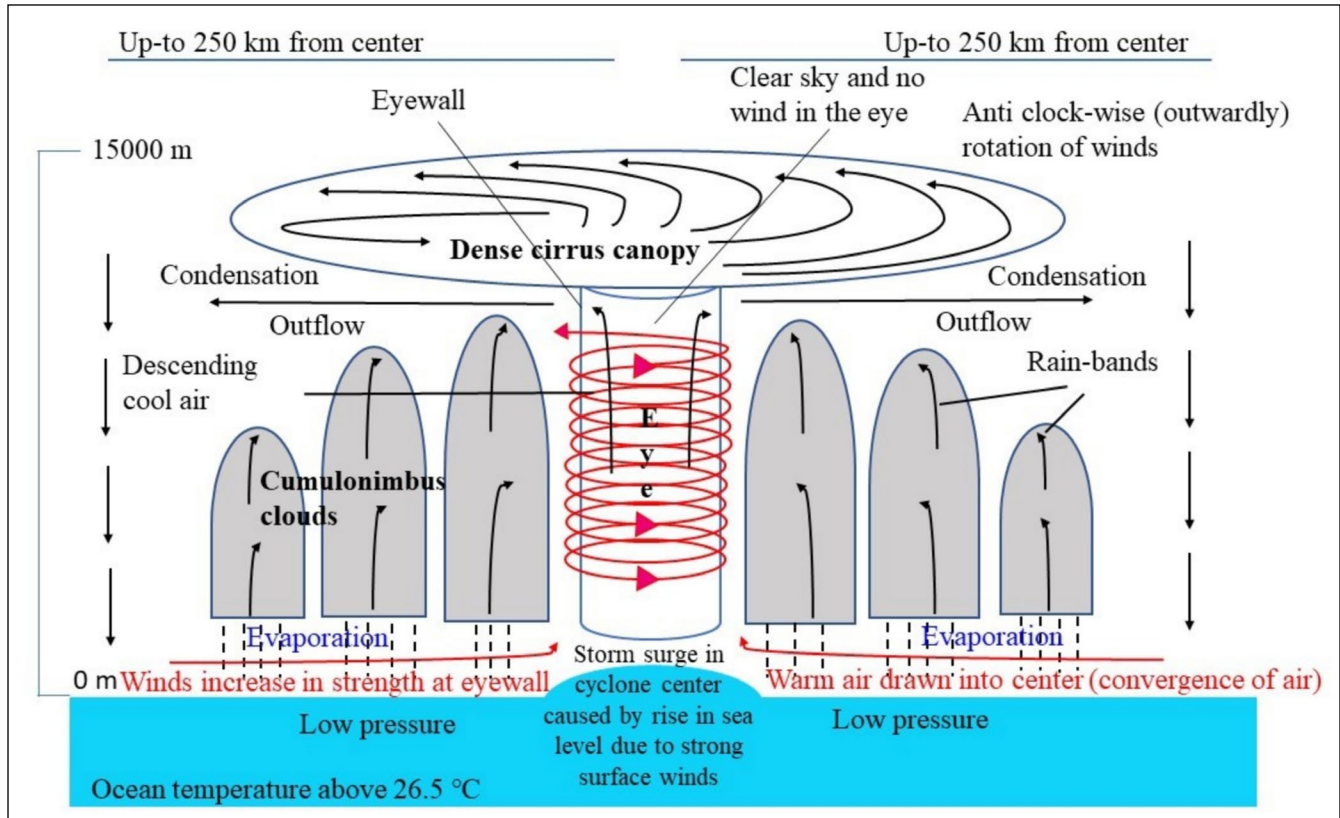


Figure 3: The structure of tropical cyclone

### 4. Categories of Cyclone

The WMO has accepted the classification scheme below, developed by the Indian Meteorological Department (IMD) to categorise low-pressure systems in the Arabian sea and Bay of Bengal based on their potential for damage (Table 1).

### 5. Disadvantages and Advantages of Cyclones

#### 5.1. Disadvantages

- Cause enormous loss to human and animal lives and severely impairs the national economy.
- Infrastructure damage, tree uprooting, collapsing of homes due to strong winds and flooding.
- Disrupt transportation systems and damage crops, leading to shortages in food supply and increased prices.
- Heavy rains lead to several negative effects on livestock and agriculture viz., soil erosion, waterlogging, increased moisture stress, anaerobic soil conditions, and pest and disease attacks on crops.

- Sea levels increase, erode beaches and embankments, thereby exposing the coastal regions to flooding.
- In anaerobic soils, floods promote de-nitrification and affects plant vigour and growth.

#### 5.2. Advantages

Interestingly, on the other hand, there are a few benefits brought about by cyclones which include:

- Groundwater table restoration in areas affected by drought and aridity due to copious rains.
- Restock depleted reservoirs for domestic and agricultural use and power generation.
- Maintenance of the global heat balance by directing warm air away from the equator and towards the poles, thereby preventing tropics becoming further warmer.
- High rainfall occurrences would help rivers remove the sediment and find new routes for the river systems to flow, increasing the amount of water available in dry places.
- Hurricanes are essential to the survival of the frangible island and construction of new island portions through additional silt deposition by the wind and waves.

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Table 1: Details of disturbances

Type of disturbances	Wind speed in km h <sup>-1</sup>	Category	Damage capacity
Low pressure	<31	-	No damage or minimal damage
Depression	31-49		
Deep depression	49-61		
Cyclonic storm	61-88		
Severe cyclonic storm	88-117		
Super cyclone	>221	1.	120 -150 km h <sup>-1</sup> : Minimal
		2.	150-180 km h <sup>-1</sup> : Moderate
		3.	180-210 km h <sup>-1</sup> : Extensive
		4.	210-250 km h <sup>-1</sup> : Extreme
		5.	250 and above km h <sup>-1</sup> : Catastrophic

## 6. Tropical Cyclone Management

India's geography, with water on three of its sides, makes it highly vulnerable to cyclones and floods. The parts of India most severely affected by cyclones are West Bengal, Odisha, Andhra Pradesh, Tamil Nadu, Kerala, and

Gujarat. The natural disasters such as tropical cyclones cannot be prevented, but we may increase our degree of readiness for when they do occur. Adoption of certain measures possess the ability to enhance the agricultural systems resilience against cyclones and reduce the extent of their damage (Ashwani et al., 2014) (Figure 4).

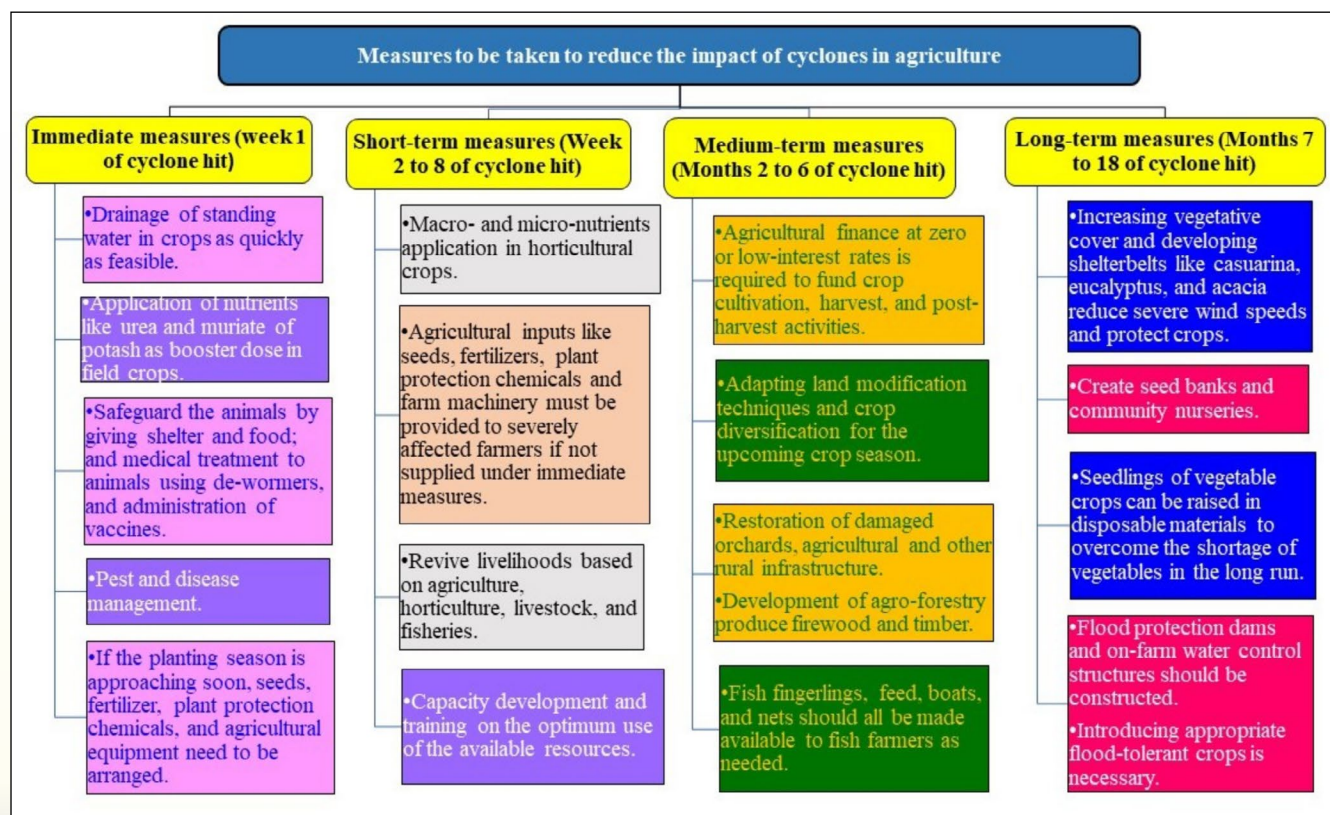


Figure 4: Measures to be taken to reduce the impact of cyclones in agriculture



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### 7. Conclusion

Understanding cyclone frequency over time, cyclone structure and formation, cyclone intensity and damage, and other related information aids in seasonal cyclone forecasting and enables farmers to take the necessary precautions to lessen the impact of cyclones on farming. Therefore, in order to prepare yourself for the challenges ahead, it's critical to stay vigilant, keep an eye out for any conditions that could lead to the formation of a cyclone, and predict the extent of the cyclone's destruction.

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