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Q18

On December 2004, tsunami brought havoc on 14 countries including India. Discuss the factors responsible for occurrence of Tsunami and its effects on life and economy. In the light of guidelines of NDMA (2010) describe the mechanisms for preparedness to reduce the risk during such events.

UPSC Civil Services Mains 2017 · GS III · 15 marks · Indian Economy

Indian Economy and issues relating to planning, mobilization of resources, growth, development and employment.

Core demand of the question

- Explain physical factors that generate a tsunami and effects on life and economy, using December 2004
- **Describe NDMA (2010)** tsunami preparedness mechanisms
- Include early warning, coastal planning, and community drills

Revision summary

The 2004 Indian Ocean tsunami was driven by a Sumatra-Andaman megathrust earthquake that displaced the sea.

India's Tamil Nadu, island, and other coasts lost lives, boats, fields, and ports.

NDMA 2010 guidelines rest on INCOIS early warning, inundation maps, CRZ siting, and last-mile alerts.

Evacuation routes, vertical refuge, mangroves, and community drills are the physical preparedness.

A warning that does not reach the beach is not preparedness.

Introduction

On **26 December 2004** a giant undersea earthquake off **Sumatra** drove an **Indian Ocean tsunami** onto **fourteen** countries. In India it killed thousands on the **Tamil Nadu** coast, **Puducherry**, **Andhra Pradesh**, **Kerala**, and above all the **Andaman and Nicobar Islands**. A tsunami is not a monsoon flood. It is a **long sea wave** born of a sudden shove of the seafloor. **National Disaster Management Authority guidelines (2010)** exist because 2004 found India almost without a public warning.

Body**Factors responsible**

- **A tsunami needs a** vertical displacement of the ocean column: usually a **thrust earthquake** on a **subduction zone** (the 2004 Sumatra-Andaman megathrust, magnitude about **9.1**).

- **Other sources:** undersea **landslides**, volcanic flank collapse, and, rarely, a large meteorite. Wind waves are not tsunamis.
- Wave speed in deep water is high (jet-airliner order); height is small at sea and **piles up** in shallow coastal water - run-up, not a single Hollywood wall everywhere.
- **Bay shape**, continental-shelf width, and coral or mangrove belts change local height. The 2004 wave hit the open Coromandel and island coasts hardest in India.
- Aftershocks and a second wave kill people who return to the beach too soon.

Effects on life and economy (2004 and generic)

- **Death and injury** from drowning and debris; children and the old die first; many bodies never identified in the Nicobars.
- **Livelihoods:** fishing boats and nets smashed; salt in fields; tourism and ports stopped.
- **Infrastructure:** roads, power, water, and the **Port Blair** and mainland harbour systems; contamination of wells.
- **Ecology:** coral breakage, mangrove damage, and saline wetlands - a long recovery.
- **Economy:** local GDP shock in coastal districts; reconstruction cost; insurance gaps for informal fishers.
- **Psychosocial** trauma and displacement camps; Andaman tribal communities were partly spared where traditional knowledge read the sea, a lesson for warning design.

NDMA (2010) preparedness mechanisms

- After 2004, the **Indian Tsunami Early Warning Centre** at **INCOIS**, Hyderabad (Ministry of Earth Sciences) sits on seismic and **ocean-buoy / tide-gauge** data and issues bulletins to NDMA, States, and the coast guard. India is a regional service provider in the **Indian Ocean Tsunami Warning System**.
- **NDMA's Guidelines for Management of Tsunamis (2010)** ask for: **hazard maps** and inundation modelling; **land-use** that keeps critical buildings and dense housing off the highest-risk strip; **Coastal Regulation Zone** discipline as a safety tool, not only an environment file.
- **End-to-end warning:** from INCOIS to State and district **Emergency Operations Centres**, police, fisheries department, and **last-mile** sirens, radio, SMS, and public address - a warning that dies in a closed office is not a mechanism.
- **Evacuation:** marked routes, **assembly grounds**, and **vertical evacuation** (upper floors of strong public buildings) where horizontal flight is too far.
- **Community:** village disaster-management plans, fisher-community training to read official alerts, school drills, and mock exercises on the 26 December memory calendar.
- **Structural:** cyclone-tsunami shelters on the east coast, mangrove and shelter-belt restoration, and port design that does not trap water.
- **Response:** pre-positioned boats, medical kits, and a clear incident command under the **Disaster Management Act, 2005**, so the 2004 chaos of overlapping agencies is not repeated.
- **International:** share seismic data; receive Pacific and Indonesian alerts as a back-up clock.

Flow diagram

Megathrust quake seafloor -> Tsunami wave
Tsunami wave -> Coastal run-up
Coastal run-up -> Death boats fields ports
INCOIS ITEWC ITEWC -> State district State district EOC
State district EOC -> Siren SMS evacuation
NDMA 2010 guidelines 2010 guidelines -> Hazard map CRZ drills

Conclusion

Tsunamis come from sudden seafloor (or landslide) displacement; 2004 showed India the death, salt, and livelihood cost. NDMA 2010 preparedness is early warning through INCOIS, mapped coasts, last-mile alerts, evacuation and vertical refuge, community drills, and CRZ-and-mangrove buffers. The mechanism works only if the bulletin reaches a fisher who still has a path off the beach.

Facts & figures

26 December 2004

Sumatra-Andaman earthquake and Indian Ocean tsunami that struck fourteen countries including India.

INCOIS ITEWC

Indian National Centre for Ocean Information Services, Hyderabad: hosts the Indian Tsunami Early Warning Centre.

NDMA tsunami guidelines 2010

National Disaster Management Authority guidance on hazard mapping, warning, evacuation, and coastal land-use for tsunamis.

DM Act 2005

Disaster Management Act that created NDMA and the institutional chain used for tsunami risk reduction after 2004.

IOTWS

Indian Ocean Tsunami Warning and Mitigation System: regional cooperation India both uses and serves.

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