ROLE OF SCIENCE AND TECHNOLOGY IN DISASTER MANAGEMENT

WHAT ARE DISASTERS?

- A disaster is an occurrence or sequence of occurrences that abruptly disrupts daily activities, severely damages people and property, and overwhelms the social and economic safety nets that are in place.
- As per the Disaster Management Act, 2005, the term Disaster is defined as "a mishap, catastrophe, calamity or grave occurrence vegetating from natural or man-made causes, by accident or negligence"
- Disasters may be man-made (environmental degradation and technological hazards) or natural (geological, hydro-meteorological and biological).

WHAT IS DISASTER MANAGEMENT?

- Disaster management is a process of effectively preparing for and responding to disasters.
- It involves strategically organizing resources to lessen the harm that disasters cause.
- It also involves a systematic approach to managing the responsibilities of disaster prevention, preparedness, response, and recovery.

SCIENCE AND TECHNOLOGY AT THE CORE OF DISASTER RISK REDUCTION

- Science and technology assist us in understanding the mechanism of natural disasters.
- Mechanism of natural disasters is a system of facts gathered from research, experiments, and observations of floods, severe storms, earthquakes, landslides, volcanic eruptions and tsunamis as well as their consequences on humans and his works.

SENDAI FRAMEWORK FOR DISASTER REDUCTION 2015-30

- The Sendai Framework for Disaster Risk Reduction was agreed during the third World Conference on Disaster Risk Reduction in March 2015, which was held in Sendai, Japan.
- The Member States' main responsibility under the framework is to lessen the specified disasters risks.

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- Its goal is to provide direction for the multi-hazard management of disasters risk in all facets of development, including at all levels and within and across all industries.
- It is the Hyogo Framework for Action (HFA) 2005-2015: Building the Resilience of Nations and Communities to Disasters' replacement instrument.

APPLICATION OF TECHNOLOGY IN DISASTER MANAGEMENT

- Even if it is impossible to prevent natural disasters completely, the suffering may be reduced by raising knowledge of the likelihood of disasters and their effects, implementing an effective warning system, and managing disasters with the use of information technology tools. We may use the following Application of technology to handle disasters:

GIS AND REMOTE SENSING

- GIS offers a tool for the effective and efficient storing and processing of remotely sensed data.
- This makes it easier to measure, map, monitor and model many forms of data that are relevant to natural phenomena.
- Hazard Mapping to display earthquake, landslide, flood or fire threats are the specialized GIS applications in the field of risk assessment.

INTERNET

- The internet offers a practical platform for communications related to disasters mitigation in the current era of electronic communication. An extremely affordable way to establish a local, national, and international presence is to launch a well-defined website.
- It offers a fresh and possibly ground-breaking choice for the quick, automated, and international transmission of disasters information.

SOCIAL MEDIA

- Many government organizations and individuals utilized Twitter in 2015 to disseminate important information about the Chennai floods.
- This served as a test case for Twitter and demonstrated to government organizations how social media platforms might be used to communicate effectively in the wake of natural disasters.
- Social media sites like Facebook, Twitter, and Instagram include a number of services including the ability to pin-point stranded individuals and mark people as safe.

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WARNING AND FORECASTING SYSTEM

- The most important factor in predicting whether a natural hazard will reach catastrophic proportions or not is an advanced system of forecasting, monitoring, and delivering early warnings.
- Area Cyclone Warning Centers send cyclone alerts to IMD (ACWCs). It has established the required infrastructure to generate and broadcast cyclone warnings at the proper volumes.
- The Cyclone Warning Dissemination System, a satellite-based communication system, has been made operational for the direct distribution of cyclone alerts to the cyclone-prone coastal areas.
- Through a countrywide network of 36 seismic stations run by the IMD, the nodal agency, seismic observations are made throughout the nation.

WEATHER RADAR

- Weather radar built along the coastal belt estimates rainfall and wind speed for a region, as well as likely tornado sites and cyclone central locations.
- Hours before the disaster, a cyclone warning or alert is given.

GPS

- The Indian government has promoted the use of digital technology to guarantee aid during emergencies. For instance, the Digital India Action Group (DIAG) just published a white paper on how to use IoT to handle disasters effectively.
- Tamil Nadu has developed TNSMART, a web-based GIS-based solution. The modules included in this application, which was created in partnership with ISRO, deal with thresholds, hazard forecasts, disaster effect forecasts, advisories, reaction plans, etc.
- Similar to this, Karnataka has a GPS-enabled system for monitoring and communicating disasters in the state in almost real-time.

ROBOTS AND DRONES FOR RESCUE OPERATIONS

- Drones and robots are cutting-edge technology with a variety of uses in daily life. It is so amazing how easily drones and robots can be programmed to do a variety of tasks. The government and other organizations rush to the scene as soon as a disaster hits to gather data on the affected region.
- They must go there right away to develop a strategy for rescue efforts.
- Robots can also be remotely dispatched inside the fallen buildings affected by earthquakes to detect and locate the victims. Typically, the robots are little vehicles with wheels and cameras.

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EARTHQUAKE WARNING SYSTEM

- An earthquake warning system provides accurate information on the earthquake's magnitude.
- The combined efforts of a seismometer, which tracks the earth's movements and an accelerometer, which tracks the acceleration of those movements, are used to determine an earthquake's magnitude. Computers show this data in analytical formats.
- The information shown on computers notifies the authorities of the disaster's severity. The warning system prompts the start of the rescue effort in a more thorough manner.

ROLE OF BIG DATA IN DISASTER MANAGEMENT

- Efficient Allocation of Resources: Big data produced by geo-informatics and remote sensing platforms aids in identifying the gaps and offer suggestions for resource allocation to reduce the danger. This entails promoting recovery, emphasizing early warning systems and evaluating resilience.
- Economic mitigation plans: Big data offers a comprehensive picture of how an economy is interrelated and how even the loss of a crop, like rice, may set off a disasters.
- Predictive Policies: Using lessons learned from prior disaster management, policymakers and first responders may identify susceptible social groups and foresee upcoming crises. Sensors are employed exclusively to gather and store data, which is then analyzed to obtain relevant data.

BLOCKCHAIN TECHNOLOGIES IN DISASTER MANAGEMENT

- Due to several testing and automation technologies that can aid in the automation of the everyday process of obtaining data in disaster-prone locations, newer technologies like Blockchain have been increasingly used in disaster management.
- This can hasten the capacity for decision-making, increase the number of rescues and help victims.
- Blockchain technology may also reduce false information and increase openness between residents and government.
- It can also help to ensure that resources are used effectively and not wasted.

DISRUPTIVE TECHNOLOGIES AND THEIR USE IN DISASTER RISK REDUCTION

- A disruptive technology is one that drastically disrupts the way customers, industries or enterprises work.
- Disruptive technologies can transmit important information more rapidly, advance early warning systems, better comprehend the causes of disasters, assess damage in novel ways, and expand our understanding of how social behaviours and economic effects change after a crisis.

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- Disaster risk reduction and management are changing as a result of advancements in disruptive technologies like artificial intelligence, the Internet of Things (IoT), Big Data, and developments in robotics and drone technology, among other fields.

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NASA FINDER DETECTS HUMAN BENEATH RUBBLE:

- The NASA Finder is a disaster management tool that resembles a suitcase.
- It is employed to save lives during earthquakes and avalanches.
- To preserve lives, prompt action and response are required. Human breaths and heartbeats are picked up by the NASA Finder in ruined structures.

DRONE USAGE DURING DISASTERS:

- Drones were employed during the 2013 Uttarakhand floods to find those who had gone missing and to survey the area for pertinent, up-to-date information for the authorities.
- IIT Madras students recently created a drone with AI capabilities that can assist authorities in providing crucial information on persons stuck in disaster-hit areas.

FOREST FIRE PREPAREDNESS:

- Forest fires may cause enormous harm if they are not quickly put out, as happened with the Australia fire in 2019. It killed over 1 billion animals and devastated almost 18 million hectares of land.
- Using helicopters or satellites, remote sensing techniques may provide thermal pictures and detect heat signatures.
- The mid-infrared and light released by the fire both during the day and at night aid in planning emergency responses, rescue operations, and agricultural protection.

NATIONAL DISASTER MANAGEMENT SERVICES (NDMS):

- In order to establish a Very Small Aperture Terminal Network connecting the Ministry of Home Affairs, NDMA, NDRF, all state/UT headquarters and 81 vulnerable districts, NDMA came up with the idea for NDMS in 2015–16.
- This pilot project's objective is to offer technical assistance and failsafe communication infrastructure for Emergency Operation Center activities across the nation.
- The project entails holding workshops and providing training to increase the functionalists' proficiency in using the communication equipment covered by this project.

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GLOBAL EXAMPLES-VIETNAM

- One of the nations with the highest risk of natural disasters is Vietnam. Support to the Disaster Management System in Vietnam (DMU project), a project financed by UNDP, has made a significant contribution to the disaster management process in Vietnam, particularly via the establishment of a national information system.
- The project established a computer-based information system that offers
  - (1) disasters forecasting
  - (2) disaster warning and response
  - (3) damage information
  - (4) rescue and relief and
  - (5) restoration and rehabilitation.
- This connection serves to provide individuals timely warnings, reacts to requests for emergency aid and spread knowledge about disaster management.

CASE STUDY

1. **TAMIL NADU:**

   TNSMART is a web-based GIS system created by Tamil Nadu. The modules included in this application, which was created in partnership with ISRO, deal with thresholds, hazard forecasts, disaster effect forecasts, advisories, reaction plans, etc.

2. **ODISHA:**

   a. The Odisha State Disaster Mitigation Authority (OSDMA) has created the "SATARK" web and mobile application (System for Assessing, Tracking and Alerting Disaster Risk Information based on Dynamic Risk Knowledge). For better disaster management, the application is designed to provide real-time watch, alert, and warning information for various hazards like heat wave, lightning, agriculture risk (drought), flood monitoring, ocean state information and tsunami risk, earthquake monitoring, and cyclone/storm surge.

   b. Odisha is the first state in the nation to have adopted an Early Warning Dissemination System (EWDS) to close the communication gap between communities and state, district, and block levels of disaster warning.

3. **KERALA:**

   A platform for crisis management has been created by the Kerala State IT Mission. Within 12 hours after the first day of floods in 2018, it was operational. The text-based rescue requests uploaded were improved to automatically collect geo-coordinates, and the geo-tagged data given by users in this portal was useful to the rescue teams during rescue operations.

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CASE STUDY: PUBLIC HEALTH DISASTER

- **Description:** The 2014 Ebola epidemic in West Africa was the biggest and most complicated disaster in history. There was an urgent need for treatment alternatives, as well as effective, culturally sensitive communication tactics and initiatives, given how quickly the disease was spreading.
- How Science and Technology Mattered during Response: Options for treatment and immunization that were being researched but hadn't yet been thoroughly reviewed were quickly vetted and then effectively implemented to the impacted countries. Prior to and during the reaction, anthropological study gave the teams battling the pandemic vital social, cultural, and political background. Responders were able to successfully combat the epidemic by ensuring sure their local interventions were suitable thanks to this knowledge.
- How Science and Technology Mattered after Response: The first Ebola vaccine was authorized after additional research and testing using information gleaned from the outbreak. In West and Central Africa, this vaccine is now being utilized to combat the illness.

CHALLENGES TO DISASTER MANAGEMENT IN INDIA

- Increasing Frequency and intensity of disasters in recent times
- The frequency of recorded hydrological disasters has risen by 7.4% year on average during the last few decades.
- Geological disasters as well as hydrometeorological disasters have a sharp rising trend. Naturally, this presents significant difficulties for disasters management in the future.
- Impact of Climate change
- Risks associated with climate change are multiplied by global warming or a rise in the average world temperature.
- The biological and societal changes brought on by the increase in global temperatures are considered the impacts of global warming.
- Therefore, the climatic changes brought on by global warming may provide difficult problems for managers in charge of disaster relief.
- Population Pressure
- Rapid population increase, particularly in metropolitan regions of emerging countries, is providing severe issues for disasters management in addition to global warming.
- Urban regions' uncontrolled expansion makes it considerably harder to react. The number of casualties from a large earthquake in any area of India's densely populated cities would be disastrous.
- Democratization of Information

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- Today, information spreads from the scene of an incident or tragedy very quickly. As a result, the reaction must be not just prompt but also sufficient and suitable.
- In order to respond effectively to this, reaction agencies would need to be well-prepared.

POLICY IMPLICATIONS

- Even though there have been notable improvements in post-disaster response and rehabilitation, lowering the likelihood of future disasters still faces difficult obstacles.
- Programs that safeguard the most at-risk groups in society must be incorporated into disaster management strategies.
- It is necessary to develop and implement mechanisms for sharing pre- and post-disaster management learning across communities.
- Given that natural disasters frequently transcend international borders, there should be greater regional collaboration to handle cross-border challenges of disaster management.
- Additionally, a strong regional response structure should be created to pool resources for mutual gain.
- If the government does not solve fundamental problems with governance and accountability, left extremism is likely to rank among the most severe threats to Indian security in the ensuing ten years.

KEY RECOMMENDATIONS FOR A STRENGTHENED USE OF SCIENCE AND TECHNOLOGY IN DISASTER RISK REDUCTION

1. Assessment of current state of scientific knowledge on disaster risks and resilience.
2. Scientific evidence synthesis in a timely and accessible manner.
3. Creating capacities to make sure that all nations can access and be able to utilize scientific knowledge.
4. To identify requirements from policy and decision-makers, including at national and local levels, and to analyze policy choices based on scientific evidence, close collaboration and conversation are used to provide scientific advice to decision-makers.
5. Monitoring and evaluation are necessary to make sure that scientific data and information can be utilized to support and track the development of DRR and resilience.
6. To achieve a successful science-policy interaction, two cross-cutting components of fundamental support would also need to be reinforced.
7. In order to identify and address requirements, policy-makers and stakeholders must communicate with scientists and conversely, scientists must be more actively involved in the development of policy in order to contribute their expertise and support.
8. An evaluation of the scientific community's current understanding of disasters risks and resilience.

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SATARK APP

- The SATARK App is the mobile adaptation of the SATARK online page, which serves as a central point for monitoring and assessing the risks related to various hazard forecasts for Odisha.
- With the help of the app, users may stay informed about various predictions, their possible effects, and the corresponding advisories based on registered and additional blocks.

FUTURE OF PREDICTION TECHNOLOGIES

- If the disaster can be forecast and individuals in the danger zone are given prior notice, deaths and injuries from natural disasters can be decreased. Over the years, a number of disasters prediction technologies have been created.
- For instance, the National Center for Atmospheric Research created Wildfire Prediction to simulate wildfires and anticipate their occurrence. Every 12 hours, the computer model is updated with the most recent satellite observations and data, enabling scientists to offer forecasts and cautions.
- Radar, computer models of streamflow and in-depth meteorological simulations are all used in flood prediction. Decision-makers can use the projections to determine whether to issue warnings.

CONCLUSION

- Technology plays a highly valuable part in disaster management. The foundation of disaster management and rapid response is technology, particularly GPS and communication. In the globe, disasters and calamities never stop. They have occurred in the past and will continue to do so. Technology is what we rely on to reduce the impact and prevent losses.