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The Role Of Science And Technology In Disaster Management

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Abstract

Disasters are the result of natural or man-made hazards that exceed society's ability to manage them. The impact of a disaster is determined by the magnitude of society's vulnerability to the hazard, which can be evaluated using the hazard's impact, society's vulnerability, and ability to manage the disaster. To minimize the impact of disasters, technology plays a crucial role in disaster mitigation by improving predictions and reducing risks through innovations such as remote sensing systems, GPS systems, and communication technologies. Science and technology have greatly influenced the integrated approach to natural disasters, with significant advances in global meteorological models, earthquake-resistant structures, and early warnings. However, solutions to disasters must also consider economic, political, and social factors, and science must be seen as part of a larger picture. By utilizing science and technology, we can work towards a safer and more resilient future.

Key Words: Disaster, Science & Technology, GPS, Robotics, Big Data, Blockchain

Introduction

The role of technology in our lives is immense and cannot be overemphasized. Over time, technological advancements have grown at an unprecedented pace, continuously adapting to the changing needs of society. The digital era has seen a surge in technological innovations, leading to a plethora of applications and platforms that make our daily routines easier. The widespread access to mobile technology and social media platforms has allowed people from all over the world to participate in disaster response and relief efforts (Reuter, C. et al., 2013).

The integration of modern technology into disaster management can be a critical factor in developing resilient and sustainable disaster preparedness and response efforts. The use of technology, such as Geographic Information Systems, monitoring systems, and computer simulations, is critical in predicting, monitoring, and assessing the impact of natural disasters (Saumya, G. Kutty, N. P., 2015). In order to effectively mitigate the risk of natural hazards turning into disasters, technology should be integrated into all aspects of disaster management.

Disaster management, also known as emergency management, is the process of developing plans and strategies to reduce the impact of hazards on communities. Its goal is not to eliminate or prevent disasters, but rather to minimize the consequences of these events [1]. According to the International Displacement

Monitoring Centre (IDMC), an average of 22.5 million people were displaced each year between 2008 and 2014 due to the direct threat of floods, landslides, storms, wildfires, and extreme temperatures [3].

The use of technology in disasters can be leveraged to mitigate harm and decrease vulnerability. Advancements in the technology and science of natural hazards and disaster response have made it possible to approach the issue of natural disasters with a more comprehensive strategy. By studying the causes of natural hazards, including atmospheric, geological, hydrological, and biological factors, technology and science allow us to better understand the mechanisms that lead to disasters. This involves interdisciplinary collaboration between basic and engineering sciences, as well as natural, social, and human sciences.

Approximately 60% of the earth's landmass is at risk of earthquakes, 40 million hectares are prone to floods, 8% of the area is vulnerable to cyclones, and 68% of the area is susceptible to droughts. Despite significant advancements in science and technology, the loss of lives and property due to disasters has not decreased over the years. In fact, the human and economic toll has increased. This led the United Nations General Assembly to declare the 1990-2000 decade as the International Decade for Natural Disaster Reduction, with the goal of reducing casualties and property damage and mitigating socio-economic impact, particularly in developing countries. [1]

A variety of technologies are utilized throughout the four phases of disaster management, including preparedness, mitigation, response, and recovery. These technologies encompass remote sensing, Geographical Information Systems (GIS), Global Positioning System (GPS), satellite navigation systems, satellite communication, amateur and community radio, television and radio broadcasting, telephone and fax, cellular phones, video conferencing, networking technologies, the internet, email, online management databases, disaster information systems and networks, and robotics. [2]

There are many applications that help in the provision of aid in times of calamities. All these technological benefits have had a significant impact on the management and eradication of disasters.

The role of technology in the disaster management cycle is often under-appreciated. It can be used at every stage of the cycle, from preparedness to response to recovery.

Preparedness: Technology can be used to help create and implement emergency plans. It can also be used to monitor potential threats, such as weather patterns that could lead to a natural disaster.

Response: In an emergency, technology can be used to coordinate and manage the response effort. It can also be used to provide information and assistance to those affected by the disaster.

Recovery: Technology can help with the rebuilding process after a disaster. It can be used to assess damage, create reconstruction plans, and coordinate relief efforts.

Mitigation: The cycle’s end points out the value of a well-rounded approach. Mitigation, like preparedness, entails doing something to lessen the chances of a disaster happening again. These measures are important at any time, but especially in the wake of a disaster when a community or organisation may still be fragile.

The Future of Disaster Management and What Role can Technology Play?

Disaster management is a critical issue that every nation must address. In the past, there were limited resources and methods available to manage disasters. However, with the progression of technology, we have gained access to advanced techniques for disaster management.

The integration of technology in disaster management is crucial. It allows us to anticipate potential threats, thus enabling us to take preventive measures. Additionally, technology enables effective communication during crisis situations, enabling collaboration and problem-solving in the event of natural disasters such as earthquakes, hurricanes, floods, and so on.

The utilization of technology in disaster management is not without debate. Some argue that technology can exacerbate the situation and lead to further harm and casualties due to potential malfunctions or human error. However, like many things in life, there are both benefits and drawbacks associated with using technology during these events, which must be considered before implementation.

Some examples include:

- Using drone technology to assess damage after an earthquake has occurred;
- Using GPS tracking systems on emergency vehicles to ensure that they do not become disoriented while responding to calls.
- The use of social media platforms like Twitter or Facebook where citizens can post pictures from their phones about what happened (e.g., where they're located), how bad it is outside right now ("shelter-in-place" orders), etc.;
- Making sure everyone knows where shelters are located so people don't have to wander around aimlessly

Technology is Helpful in Disaster Management

Disasters can strike without warning and come in various forms, from minor fires to devastating earthquakes. They can quickly destroy everything you hold dear, leaving you feeling helpless and vulnerable. However, there are steps you can take to reduce the impact and ensure your family's safety.

The role of technology in disaster management is crucial. This guide highlights how technology can help monitor earthquakes, hurricanes, and provide real-time updates about changing conditions, thus allowing emergency responders to act promptly and evacuate people from danger.

Technology can also provide vital information about the location of an earthquake's epicenter, allowing emergency services to plan and coordinate their response effectively. Similarly, technology can help monitor hurricanes and keep residents informed of evolving conditions, giving them ample time to prepare and protect themselves.

Though technology cannot replace basic necessities such as food, shelter, water, and the comfort of loved ones during a disaster, it plays a significant role in enhancing disaster management and response efforts. By leveraging technology, we can better prepare for and respond to emergencies, reducing the impact and helping to save lives.

- Aerial Robotics: It assesses damage in real-time, increases situational awareness through high-resolution mapping and delivers items faster, cheaper and more efficiently. E.g. Global Non-profit We-Robotics Program Assistance Robotics identifies local human needs and provides robotics solutions through regional flying labs
- Social Media Solutions: Resulting in faster, more effective answers that ultimately help the beneficiaries. For example, World Food Program (WFP) Mobile Vulnerability Analysis and Mapping (mVAM) uses mobile technology to address the barriers of data collection
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Role of big data in disaster management

Big data has the potential to support early detection of various aspects of floods, such as potential inundation, duration, and river discharge, by integrating data from different sources. Remote sensing data and information from social media can both play crucial roles in flood prediction and impact analysis. For example, Jongman et al. (2015) combined data from disaster response organizations, remote sensing data from the Global Flood Detection System (GFDS), and social media data from flood-related Twitter activities to gain a faster understanding of the location, timing, and impact of floods. They utilized Floodtags, an automated social media analytics platform, to filter, visualize, and map social media content related to flood events based on location and keywords.

- Predictive Policies: This can be developed from previous disaster management; officials and responders can collect insights that help forecast future incidents and identification of vulnerable social sections. Sensors are used specifically for data collection and storage which are later analysed and extracted useful data from it. Companies like Google are predicting flood patterns in India and aiming to improve reaction accuracy and precision

- Efficient Allocation of Resources: Big data generated from geo-informatics and remote sensing platforms helps identify the gaps and make recommendations on where to allocate resources to mitigate the risk. This includes helping to see recovery, focusing on early warning dissemination systems and assessing resilience
- Economic mitigation plans: Big data provides an in-depth understanding of how an economy is interconnected and how even the destruction of a crop like rice can trigger a disaster. A series of effects on many industries and services such as transportation, rice trade, packaging and retail
- Social media also collects data and allows survivors to mark themselves safely in times of crisis, which is helpful for both emergency response teams and distressed friends and family
- The American Red Cross puts life-saving information at the user's fingertips through free mobile apps. The app gives people instant access to over 35 custom weather alerts
- A pilot project was carried out by Google in collaboration with the Central Water Commission to assess the flood situation in Patna
- The Odisha State Disaster Mitigation Authority (OSDMA) has also developed a web and smartphone-based platform called "SATARK" in collaboration with the regionally integrated Multi-Hazard, early warning dissemination system. The application is designed to provide real-time clocks, alerts and warning information for various hazards such as heatwave, lightning, agricultural hazards (drought) and flood monitoring. This is a big role of the national disaster management system

» 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.

» 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.

Blockchain Technologies in Disaster Management

This study examines the application of blockchain technology in disaster management. The authors provide an overview of the literature on blockchain technology and its relationship to disaster management. Blockchain is a decentralized database connected through a peer-to-peer network, making it a trustless system (Böhme et al., 2015). The technology is centered around the decentralized network and its distributed database (Glaser, 2017). The nodes in the network verify transactions using a consensus algorithm and communicate securely with each other using Public Key Infrastructure. Each block in the chain contains information about all transactions, a hash code for the current block, a hash of the previous block, and a timestamp (Glaser, 2017). All completed transactions are stored on every node in the network, forming a public ledger.

The usage of newer technologies like Blockchain has been continuously increasing in disaster management due to wide use cases in several testing and automating technologies that can help in the automising daily task of gathering data in disaster-prone regions. This can help speed up decision-making capacity and aid in increasing rescues and helping victims.

Blockchain technologies can also help minimise misinformation and build transparency between government and locals. It can also aid such that proper utilisation of resources is carried out and not wasted.

Robotics

A variety of technologies are utilized throughout the four phases of disaster management, including preparedness, mitigation, response, and recovery. These technologies encompass remote sensing, Geographical Information Systems (GIS), Global Positioning System (GPS), satellite navigation systems, satellite communication, amateur and community radio, television and radio broadcasting, telephone and fax, cellular phones, video conferencing, networking technologies, the internet, email, online management databases, disaster information systems and networks, and robotics (Pardeep. S.M and Ariyabandu).

Robotics are specialised technologies that can be used in a disaster management scenario. Robots are now incredibly advanced and prepared to better help and complement human actors or rescue animals thanks to advancements in computing technology. These can be incredibly useful for NDRF units, particularly in difficult terrain and life-threatening operations.

Robots and drones are the emerging technologies having applications in different sectors of life. It is so surprising that robots and drones can be modified for work in almost every situation.

Whenever a disaster strikes the first thing that the government and other agencies do is to reach quickly and gather information on the hit area. They need to quickly visit to plane a strategy and rescue operations.

The role of recent technologies like drones and robots in disaster management is marvelous.

The drones are very helping full in reaching those areas quickly where a human cannot reach due to the wreckage. It gathers the information with the cameras installed and live video recordings.

It can view the damage from a different angle that helps the rescue team to conduct the operation. It is used to drop aid and food for the victims.

The same is the role of robots it can be remotely sent into the crakes' collapsed buildings to find and locate the victims. The robots are usually small vehicles with wheels and cameras installed.
In emergency and rescue operations time is an important factor for saving lives. As humans can not go inside small crakes and holes. The robots quickly locate the victims in the wreckage for quick rescue operations.

NASA Finder detects human beneath rubble:

The role of science and technology in the field of disaster management is very excellent and promising in saving lives. NASA Finder is a suitcase-type device used in disaster management. It is used in earthquakes and avalanches to save people.

In emergencies when an earth quack and avalanches hit an area severely. Timely response and quick operation are needed to save lives. NASA finder detects heartbeats and respiration of human beings in the wrecked buildings or debris.

A human can not detect the precise place where the victim is stuck in concrete. It can detect human or another living being in 20 feet of solid concrete.

Finder is the quickest and reliable tool to Quickly find and aid the victim. Finder was used in many sever earth quacks and disasters and it showed very promising results.

Earthquake warning system:

Earthquake is one of the horrific natural disasters that hugely affect the lives of millions around the globe. To counter the damaging effects the role of science and technology in the field of disaster management is advantageous. An earthquake warning system gives precise knowledge about the magnitude of the earthquake. It measures the magnitude of an earthquake by the combined work of a seismometer that measures the motions of the earth and an accelerometer that measures the acceleration of the earth's movement. This data is displayed on computers in analytical forms. The data displayed on computers alert the authorities of the severity of the disaster. The rescue operation is initiated more comprehensively according to the warning system. In a previous study, SEER conducted a seismic hazard assessment using a deterministic approach (Adnan et al., 2002). This method calculates the seismic hazard based on the most severe earthquake scenario that is expected in a region, including the estimation of the maximum magnitude that is likely to occur. As illustrated in Figure 4, the results of the deterministic analysis divided the PGA map of Peninsular Malaysia into two zones. The first zone ranges from 30 gals to 50 gals on the eastern side of the Peninsular, while the second zone ranges from 50 gals to 80 gals on the western side, according to the JKR guideline of 2009.

Forest fire preparedness:

Forests play a crucial role in providing a variety of ecosystem services and benefits that are vital to communities, both urban and rural, rich and poor, and at local and global levels [27,29]. These services can be classified as provisioning services, such as timber, fuel wood, and non-timber forest products, regulating services, like carbon storage, water availability and quality, cultural services, such as scenic landscapes and sacred lands, and supporting services, such as soil formation and plant growth [29-31]. For example, forests contribute to nearly 75% of the world's water supply. The ecosystem services provided by forests globally are estimated to be worth around USD $9.4 trillion [32]. Biodiversity in forests is not just an ecosystem service but also a critical component of a healthy forest ecosystem, contributing to the provision of other ecosystem services [33]. Forest structural diversity, including vertical and horizontal heterogeneity and the presence of large trees, is another key factor in the supply of ecosystem services [34]. Forest fires are a great threat to the lives of animals and humans. it can damage the property and result in huge economic losses. It is one of those disasters that take place at a slow pace and expand tremendously. After expansion, it is very difficult to curb its dangerous harm.

If forest fires are not curbed on time they can end up in massive destruction like the Australia fire in 2019. Where it destroyed around 18 million hectares of land killed almost 1 billion animals. Keeping in mind the severity and damage resulting from fires. The technology has been incorporated to timely handle the disaster. Remote sensing and thermal images and heat signatures from the above-using helicopters or satellites. The mid-infrared and light emitted from the fire during day and night also help in preparing response, rescue operations, and protecting economically important farms. The images also help in the assessment and mapping of vegetation and burned land for covering the losses.

GIS and Remote Sensing

High-resolution remote sensing images collected immediately after a disaster and made available on a web portal, as well as images volunteered from around the world, can be used to map the extent of damage. Crowd mapping using remote sensing imagery has become a common practice in the aftermath of a catastrophe, starting with the Haiti earthquake in 2010. During the Haiti earthquake, volunteers from OpenStreetMap (OSM) from all over the world downloaded satellite images to assess infrastructure damage, which was further augmented by input from local volunteers. (Zook et al., 2010).

The Digital Elevation Model (DEM) is a three-dimensional representation of the terrain's surface that shows the extent of flooding and its depth. It is created by subtracting the water level from the elevation of each cell in a raster. However, its accuracy can be impacted by its high reliance on remotely sensed data, which can lead to substantial errors in flood estimation, with a 1 meter vertical error in the DEM model potentially producing hundreds of square kilometers of error. To address this issue, it is crucial for DEMs in hydrological modeling to account for these errors, as highlighted in the perspective of flood mapping (Hunter et al., 1995).

» 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

In 2012, Kavanaugh et al. explored the utilization of social media (SM) in crisis management by government officials, businesses, and the general public. The study involved 25 focus group interviews with officials and the results were analyzed using a combination of Wordle and Perl script, focusing on the Twitter, Facebook, YouTube, and Flickr platforms. The authors divided the challenges into two categories: information and organization factors. The information factors were further divided into technology, communications, and information, while the organization factors were split into legal, policy, costs, and training.

In a qualitative analysis of risk communication, Lambert (2020) delves into the Facebook platform and examines how it enables the exchange of information, promotes transparency, builds trust, and provides support during disasters. Meanwhile, Lieneck et al. (2022) conducted a review on the barriers to promoting Covid-19 vaccines on social media in the USA. The study found that the spread of false information, declining vaccine acceptance among social media users, and a lack of regulations on social media were the major hindrances.

Technologies such as Social Networking Services (SNS) (Yin et al., 2015), Open Street Maps, Sensor Networking systems (Erdelj, Król, & Natalizio, 2017), Internet of Things (IoT), and Unmanned Aerial Vehicles (UAVs) (Erdelj, Natalizio, Chowdhury, & Akyildiz, 2017), as well as Virtual Reality (VR) training systems (Li, Liang, Quigley, Zhao, & Yu, 2017), have been utilized in various phases of disaster management. Furthermore, ongoing research is exploring technological innovations in crisis management. The risk reduction phase is proactive and aims to protect, predict, and prevent damage through the use of monitoring technologies that record real-time information and showcase the vulnerability of risks. In the preparedness phase, local authorities provide training to the public through SNS with VR experiences to help them respond to disasters. During a disaster, situational awareness is crucial, and social media and Open Street Maps enable people to gain relevant information. The information systems used in previous phases are also necessary for effective recovery operations (Sakurai & Murayama, 2019).

» 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.

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

The capturing of images from satellites is hindered by unfavorable weather conditions, particularly cloud cover which affects the clarity of the images. This presents a major challenge in flood monitoring (Rashid et al., 1993). Synthetic Aperture Radar (SAR) and optical remote sensing imagery have emerged as the most popular methods for managing floods (Chen et al., 1999). The key advantage of SAR imagery is its ability to produce sharp images in all weather conditions. The radar backscatter is recorded based on the incidence angle of the sensor and the Digital Number (DN) (Chen et al., 1999). To create a color composite, two images of the same area captured before and after the flood are projected into red, green, and blue channels using multi-data SAR (Long et al., 2001).

» 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 application of GPS in disaster management extends beyond handheld devices, as it is often integrated into various platforms. In 2007, Lewis utilized a digital imaging platform in the form of an Unmanned Aerial Vehicle (UAV) for emergency response. The UAV was equipped with a collection of sensors and autopilots that captured images, while GPS provided the coordinates of different locations as the UAV flew over the study site. This study was featured in the publication "Geomatics solutions for disaster management."

» 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.

Use of DRONE 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.

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

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.

Global Observations and Recommendations

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.

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.

Discussion

Disasters are the result of natural hazards affecting society. Hazards can be either natural or man-made, and if the impact of a natural hazard is so severe that it exceeds a society's ability to manage it, it can escalate into a disaster. The effects of a disaster depend on the magnitude of a society's vulnerability to the hazard.

Humans have continuously struggled with natural disasters, but as they have progressed socially and economically, they have become better equipped to deal with these challenges. The risk of a disaster can be evaluated based on three factors: the hazard's impact, the society's vulnerability to the hazard, and its ability to manage the disaster.

Minimizing the impact of hazards is crucial and can be achieved by following guidelines from the relevant authorities. Effective controls protect people from hazards, preventing injuries, diseases, and incidents. These controls can include administrative measures, personal protective equipment, substitution, and engineering controls.

The first step is to identify control options by collecting and reviewing information with employees to understand the types of hazards and who may be exposed. Next, select controls that are effective, permanent, and feasible. Then, develop a hazard control plan that outlines how the controls will be implemented, prioritizing the most serious hazards first. It is essential to monitor progress and verify that the controls are operating effectively. The hazard control plan should protect workers during both normal operations and disasters.

Once the hazard control and prevention methods have been identified, they should be implemented according to the hazard control plan. Employers should regularly evaluate the controls and track progress, following routine maintenance practices. The goal is to ensure the safety of workers and prevent the devastating effects of disasters.

Conclusion

Disasters can cause devastating consequences to human life, animals, and property. As the earth's resources are increasingly depleted, the vulnerability to natural hazards has increased. To minimize the impact of these disasters, it's crucial to study them using modern technology and find operational precautionary measures. Technology can significantly aid the disaster mitigation process by improving future predictions. The integration of remote sensing systems with Geographic Information Systems and web technology has made it a potent tool in detecting signs of natural disasters. The critical information dissemination via the Internet shortens the data acquisition time and provides a real-time disaster prediction capability. The implementation of these technological advancements can reduce disaster risks.

The world is rapidly changing its approach to disasters and technology plays a critical role in this transformation. From GPS systems to communication technologies, disasters are being met with a more sophisticated and effective response. Leaders at all levels must acknowledge the importance of disaster reduction and the role of technology in making it a reality. The 21st century presents one of the greatest challenges in using science and technology to prevent and reduce the impact of disasters. Although we cannot prevent an earthquake or hurricane from occurring, we can make our infrastructure more resilient and issue early warnings, thus reducing the loss of life and property.

Over the past three decades, the knowledge of natural hazards and the technologies to tackle them have grown dramatically. The United Nations declared the International Decade for Natural Disaster Reduction (1990-1999) to make use of the existing scientific and technological knowledge and gain new knowledge to inform public policy on disaster prevention. The International Strategy for Disaster Reduction builds on this effort and provides a framework for nations to fully utilize the knowledge on disaster protection.

Science and technology have greatly influenced the integrated approach to natural disasters. They provide an understanding of the mechanism of natural hazards and help analyze how these hazards become disasters. The disciplines involved in this field range from basic and engineering sciences to natural, social and human sciences, including hydrology, geology, geophysics, seismology, volcanology, meteorology, biology, engineering, architecture, sociology, humanities, political sciences, and management science. There have been significant advances in global meteorological models and their application to weather prediction, providing critical information on global climate change and its impact on the environment.

However, it's important to note that the solutions to the problems of disasters must be rooted in social realities. Science must be seen as part of a larger picture that includes economic, political, and social factors. By utilizing science and technology, we can make strides towards a safer and more resilient future.

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