

## EVS ASSIGNMENT

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### SECTION:A

QUESTION:1--> Shifting to renewable energy resources is going to be very vital for developing countries in order to tackle the problems of pollution, achieving Climate related targets, social upliftment and economic development. Also discuss the uses, advantages and disadvantages of any two renewable energy resources which you think have high potential in India.

#### ANSWER:

Shifting to renewable energy resources is a crucial step for developing countries, particularly for tackling the myriad problems associated with pollution, climate change, and sustainable development. For a country like India, which is on a fast track of economic growth and industrialization, the adoption of renewable energy can serve as a catalyst for social upliftment and economic development. The vast and diverse geography of India provides it with immense potential for harnessing various renewable energy sources. In this essay, we will explore the importance of renewable energy for India and delve into the uses, advantages, and disadvantages of two key renewable energy resources: solar energy and wind energy.

### Importance of Renewable Energy for Developing Countries

#### . Tackling Pollution

Developing countries like India are often burdened with severe pollution problems due to rapid urbanization, industrialization, and reliance on fossil fuels. Renewable energy sources such as solar and wind power generate electricity without emitting pollutants, thus reducing air and water pollution and improving public health.

#### . Achieving Climate-related Targets

India is a signatory to the Paris Agreement, which aims to limit global warming to well below 2 degrees Celsius. Transitioning to renewable energy is essential for India to meet its climate-related targets and contribute to global efforts to mitigate climate change. Renewable energy sources do not emit greenhouse gases, thereby helping to reduce the carbon footprint.

#### . Social Upliftment

Access to clean and affordable energy can significantly improve the quality of life in rural and underserved areas. Renewable energy can provide electricity to remote villages, powering schools, healthcare centers, and homes, thereby promoting education, health, and overall well-being.

#### . Economic Development

The renewable energy sector can be a significant driver of economic growth. It can create jobs, stimulate technological innovation, and reduce dependence on imported fossil fuels. Investing in renewable energy infrastructure can also lead to the development of local industries and provide a sustainable energy supply for future generations.

#### . Solar Energy

##### --> Uses

Solar energy is harnessed using photovoltaic (PV) panels and solar thermal systems. PV panels convert

sunlight directly into electricity, which can be used for residential, commercial, and industrial purposes. Solar thermal systems use sunlight to generate heat, which can be utilized for water heating, space heating, and power generation.

### Advantages

1. **Abundance:** India receives about 300 sunny days per year, making it one of the most solar-rich countries in the world. This abundance of sunlight provides a reliable and consistent source of energy.
2. **Environmental Benefits :** Solar energy is a clean and green source of energy. It does not produce any greenhouse gases or pollutants, thus contributing to a reduction in air pollution and climate change mitigation.
3. **Energy Independence :** By harnessing solar energy, India can reduce its reliance on imported fossil fuels, enhancing its energy security and reducing the vulnerability to global energy market fluctuations.
4. **Job Creation:** The solar energy sector has the potential to create millions of jobs in manufacturing, installation, maintenance, and research and development. This can help in reducing unemployment and fostering economic growth.
5. **Rural Electrification:** Solar energy can be a game-changer for rural areas that are not connected to the national grid. Solar panels can provide electricity for lighting, cooking, and powering small appliances, thus improving the quality of life in remote areas.

### --> Disadvantages

1. **High Initial Costs:** The installation of solar panels and associated infrastructure can be expensive. Although the cost of solar panels has decreased significantly in recent years, the initial investment can still be a barrier for widespread adoption.
2. **Intermittency:** Solar energy generation is dependent on weather conditions and time of day. Cloudy days and nighttime reduce the efficiency of solar panels, necessitating the use of energy storage systems or backup power sources.
3. **Land Use:** Large-scale solar power plants require significant amounts of land, which can lead to land use conflicts, especially in densely populated regions. This can also impact local ecosystems and agricultural activities.
4. **Energy Storage:** Efficient and cost-effective energy storage solutions are essential to ensure a stable and reliable power supply from solar energy. Current battery technologies are still evolving, and high storage costs can limit the scalability of solar power systems.

### . Wind Energy

#### --> Uses

Wind energy is harnessed using wind turbines that convert the kinetic energy of wind into mechanical power, which is then converted into electricity. Wind farms, comprising multiple wind turbines, can be installed onshore or offshore to generate large amounts of electricity.

#### --> Advantages

1. **Renewable and Sustainable:** Wind energy is a renewable source of energy that is abundant and inexhaustible. India has a vast potential for wind energy, especially in coastal areas and high-altitude regions.

2. **Low Operating Costs:** Once installed, wind turbines have relatively low operating and maintenance costs. The fuel (wind) is free, and modern wind turbines have long lifespans, making wind energy a cost-effective solution in the long run.
3. **Environmental Benefits:** Wind energy is a clean source of energy that does not produce greenhouse gases or other pollutants. It helps in reducing carbon emissions and combating climate change.
4. **Energy Independence:** By utilizing wind energy, India can reduce its dependence on imported fossil fuels, enhancing its energy security and reducing exposure to volatile global energy markets.
5. **Rural Development:** Wind farms can be established in rural areas, providing local communities with job opportunities and infrastructure development. This can lead to improved economic conditions and social upliftment in these regions.

#### --> Disadvantages

1. **Intermittency:** Wind energy generation is dependent on wind speed and weather conditions. Wind turbines require a minimum wind speed to operate efficiently, and variations in wind patterns can affect the consistency of power generation.
  2. **High Initial Costs:** The installation of wind turbines and the development of wind farms require substantial upfront investments. The costs of land acquisition, infrastructure development, and grid integration can be significant barriers.
  3. **Land Use and Aesthetics:** Wind farms require large areas of land, which can lead to land use conflicts and impact local ecosystems. Additionally, some people consider wind turbines to be visually unappealing, leading to opposition from local communities.
  4. **Noise and Wildlife Impact:** Wind turbines generate noise, which can be a concern for nearby residents. There is also evidence that wind turbines can impact bird and bat populations, although modern designs aim to minimize these effects.
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QUESTION:2-->. 'Plastic waste is a by-product of urban lifestyle and is considered as a necessary evil'. Provide your critical views on this statement, focusing on utility of plastic in the growth of urban lifestyle and impacts of plastic waste on the environment.

#### ANSWER:

Plastic waste is often deemed a by-product of urban lifestyle and is considered a necessary evil. This duality underscores the complexity of our relationship with plastic: while it plays an integral role in modern living, its environmental impact is profoundly negative. This essay critically examines the utility of plastic in urban growth and the deleterious effects of plastic waste on the environment.

#### . Utility of Plastic in Urban Lifestyle

##### --> Versatility and Convenience

One of the most significant benefits of plastic is its versatility. It can be molded into various forms and used in countless applications. From packaging and household goods to medical devices and automotive parts, plastic's adaptability is unmatched. This versatility supports urban lifestyles by providing convenient, lightweight, and durable products.

##### --> Economic Benefits

Plastics contribute significantly to the economy. The plastic industry generates employment opportunities, drives innovation, and supports numerous other sectors, including healthcare, construction, and electronics. For instance, in healthcare, plastic is used in the manufacturing of syringes, IV bags, and various disposable medical instruments, which are critical for maintaining hygiene and preventing infections.

#### --> Enhanced Food Preservation

Plastic packaging plays a crucial role in preserving food, reducing food waste, and ensuring food safety. Plastic containers, wraps, and films extend the shelf life of perishable goods by protecting them from contamination, moisture, and damage. This is particularly important in urban areas where the demand for packaged and ready-to-eat food is high due to busy lifestyles.

#### --> Infrastructure and Construction

In construction, plastics are used for piping, insulation, and even structural components. They offer durability, flexibility, and resistance to corrosion, which are essential for the development and maintenance of urban infrastructure. The lightweight nature of plastic also makes it easier to transport and handle, reducing construction costs and improving efficiency.

### . Impact of Plastic Waste on the Environment

#### --> Pollution and Ecosystem Damage

Plastic waste is a major environmental pollutant. It contaminates soil, water, and air, leading to severe consequences for ecosystems and wildlife. Marine environments are particularly vulnerable, as plastic waste often ends up in oceans, harming marine life through ingestion and entanglement. Birds, fish, and other animals mistake plastic debris for food, leading to injury, malnutrition, and death.

#### --> Microplastics and Human Health

Microplastics, tiny plastic particles resulting from the degradation of larger plastic waste, pose a significant threat to human health. These particles are pervasive in the environment, entering the food chain through water, soil, and air. Studies have shown that microplastics can carry harmful chemicals and pathogens, potentially leading to health issues such as hormonal disruptions, reproductive problems, and even cancer.

#### --> Greenhouse Gas Emissions

The production and disposal of plastic contribute to greenhouse gas emissions. The manufacturing process relies heavily on fossil fuels, releasing significant amounts of carbon dioxide and other greenhouse gases into the atmosphere. Additionally, when plastic waste is incinerated, it releases toxic pollutants and more greenhouse gases, exacerbating climate change.

#### --> Resource Depletion

Plastics are derived from non-renewable resources like petroleum and natural gas. The extraction and processing of these resources have considerable environmental footprints, including habitat destruction, water pollution, and energy consumption. The continued reliance on fossil fuels for plastic production is unsustainable and contributes to the depletion of finite natural resources.

### . Balancing Utility and Environmental Impact

#### --> Recycling and Waste Management

Improving recycling and waste management practices is crucial for mitigating the environmental impact of plastic waste. Enhancing recycling infrastructure, promoting the use of biodegradable and compostable plastics, and encouraging the reduction, reuse, and recycling of plastic products can significantly reduce the volume of plastic waste. Public awareness campaigns and educational programs can also play a vital role in changing consumer behavior and promoting sustainable practices.

#### --> Innovation in Plastic Alternatives

Investing in the development of sustainable alternatives to conventional plastics is essential. Researchers are exploring bioplastics made from renewable resources like cornstarch, algae, and even food waste. These alternatives have the potential to reduce the environmental footprint of plastic production and disposal. However, it is crucial to ensure that these alternatives are truly sustainable and do not pose other environmental or social challenges.

#### --> Policy and Regulation

Governments play a pivotal role in addressing the plastic waste crisis through policy and regulation. Implementing bans on single-use plastics, incentivizing the use of recycled materials, and setting targets for plastic waste reduction can drive systemic change. International cooperation and agreements are also necessary to tackle the global nature of plastic pollution.

#### --> Corporate Responsibility

Corporations must take responsibility for the plastic waste generated by their products. Extended producer responsibility (EPR) programs can hold manufacturers accountable for the entire lifecycle of their products, encouraging them to design for sustainability and invest in recycling initiatives. Transparency in reporting plastic usage and waste management practices can also foster consumer trust and drive corporate accountability.

#### . Case Studies: Successes and Challenges

##### --> The European Union's Plastic Strategy

The European Union (EU) has implemented a comprehensive strategy to tackle plastic waste, including a ban on certain single-use plastics, targets for plastic recycling, and the promotion of circular economy principles. This strategy has led to significant reductions in plastic waste and increased recycling rates. However, challenges remain in harmonizing regulations across member states and ensuring compliance.

##### --> India's Plastic Waste Management

India has taken significant steps to address plastic waste, including bans on single-use plastics and initiatives to promote plastic recycling. The country's Plastic Waste Management Rules, 2016, mandate that producers, importers, and brand owners take responsibility for managing plastic waste. Despite these efforts, India faces challenges in enforcement, infrastructure development, and public awareness.

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### SECTION:B

QUESTION.1-->. Computer science plays a crucial role in creating sustainable solutions. What are the applications of computer science in the environmental sciences?

ANSWER:

Computer science has become an indispensable tool in addressing various global challenges, including those related to environmental sustainability. The integration of computer science with environmental sciences has led to the development of innovative solutions for monitoring, managing, and mitigating

environmental issues. This essay explores the diverse applications of computer science in environmental sciences, highlighting how technologies such as data analysis, artificial intelligence (AI), geographic information systems (GIS), and the Internet of Things (IoT) are contributing to sustainable environmental solutions.

## . Data Analysis and Environmental Monitoring

### -->Big Data Analytics

The vast amounts of data generated from environmental sensors, satellite imagery, and other monitoring systems require sophisticated data analytics techniques. Big data analytics helps in processing and analyzing these large datasets to identify patterns, trends, and anomalies. For example, climate scientists use big data analytics to study weather patterns, predict climate change impacts, and develop mitigation strategies.

### --> Remote Sensing

Remote sensing technology involves the use of satellites and aircraft to collect data about the Earth's surface. Computer algorithms process and analyze this data to monitor changes in land use, vegetation cover, water bodies, and atmospheric conditions. Remote sensing is crucial for tracking deforestation, urbanization, and natural disasters, providing valuable information for environmental management and policy-making.

### --> Environmental Informatics

Environmental informatics is a multidisciplinary field that combines computer science, environmental science, and information technology to manage and analyze environmental data. It involves the development of databases, data models, and information systems to store, retrieve, and visualize environmental data. These systems support decision-making processes in environmental management, conservation, and research.

## . Artificial Intelligence and Machine Learning

### --> Predictive Modeling

Artificial intelligence and machine learning algorithms are used to develop predictive models for various environmental phenomena. These models can forecast weather conditions, predict the spread of wildfires, and estimate the impacts of climate change. For instance, machine learning models can analyze historical weather data to predict future rainfall patterns, helping farmers and water resource managers plan for irrigation and water conservation.

### --> Biodiversity and Species Conservation

AI techniques are employed to monitor and conserve biodiversity. Machine learning algorithms can analyze data from camera traps, audio recordings, and other sources to identify species, estimate population sizes, and detect changes in habitat. This information is critical for developing conservation strategies and assessing the effectiveness of protected areas.

### --> Pollution Control

AI is also applied in pollution control and management. Machine learning models can predict air and water pollution levels based on historical data and real-time sensor inputs. These predictions enable authorities to implement timely measures to reduce pollution and protect public health. Additionally, AI-driven systems can optimize industrial processes to minimize waste and emissions.

## . Geographic Information Systems (GIS)

### --> Spatial Analysis

Geographic Information Systems (GIS) are used to analyze spatial data and create maps that visualize environmental information. GIS applications in environmental sciences include mapping deforestation, tracking wildlife movements, and assessing the impacts of natural disasters. Spatial analysis helps in understanding the spatial distribution of environmental phenomena and planning effective interventions.

### --> Land Use Planning

GIS is essential for sustainable land use planning and management. By integrating data on soil quality, vegetation, water resources, and human activities, GIS can identify suitable areas for agriculture, urban development, and conservation. This ensures that land is used efficiently while minimizing environmental impacts.

### --> Disaster Management

GIS plays a vital role in disaster management by providing tools for hazard mapping, risk assessment, and emergency response planning. During natural disasters such as floods, earthquakes, and hurricanes, GIS can help identify vulnerable areas, coordinate rescue operations, and assess damages. This improves the resilience of communities to environmental hazards.

## . Internet of Things (IoT)

### --> Environmental Monitoring Networks

The Internet of Things (IoT) involves the use of interconnected sensors and devices to collect and transmit environmental data in real-time. IoT-based environmental monitoring networks can measure air and water quality, soil moisture, temperature, and other parameters. This real-time data enables early detection of environmental problems and timely interventions.

### --> Smart Agriculture

IoT applications in agriculture, also known as smart agriculture, enhance the efficiency and sustainability of farming practices. Sensors placed in fields can monitor soil conditions, crop health, and weather conditions. This data is analyzed to optimize irrigation, fertilization, and pest control, reducing resource use and environmental impacts while increasing crop yields.

### --> Waste Management

IoT technology is also applied in waste management to monitor and optimize waste collection and disposal. Smart bins equipped with sensors can track fill levels and send alerts when they need to be emptied. This improves the efficiency of waste collection, reduces costs, and minimizes environmental pollution.

## . Climate Change Mitigation and Adaptation

### --> Carbon Footprint Analysis

Computer science tools are used to calculate and analyze carbon footprints at individual, organizational, and national levels. Software applications can estimate greenhouse gas emissions from various activities, helping entities identify major sources of emissions and develop strategies to reduce them. This contributes to global efforts to mitigate climate change.

## --> Renewable Energy Management

Computer science facilitates the management and optimization of renewable energy systems. For example, algorithms can predict solar and wind energy generation based on weather forecasts and historical data. This information helps in balancing energy supply and demand, integrating renewable energy into the grid, and reducing reliance on fossil fuels.

## --> Climate Modeling

Climate models are complex computer simulations that predict future climate scenarios based on different greenhouse gas emission pathways. These models incorporate data from various sources and simulate the interactions between the atmosphere, oceans, land surface, and ice. Climate modeling provides insights into potential climate impacts and informs policy decisions on climate change mitigation and adaptation.

## . Sustainable Urban Development

### --> Smart Cities

The concept of smart cities involves using technology to improve the efficiency and sustainability of urban services. Computer science plays a crucial role in developing smart city solutions, such as intelligent transportation systems, energy-efficient buildings, and waste management systems. These solutions enhance the quality of life in urban areas while reducing environmental impacts.

### --> Urban Planning and Management

Computer-based tools are used in urban planning and management to design sustainable cities. Software applications can simulate urban growth, analyze transportation networks, and assess the impacts of different planning scenarios. This helps urban planners make informed decisions that promote sustainable development and minimize environmental degradation.

### --> Energy Management

Energy management systems use computer algorithms to monitor and control energy consumption in buildings and infrastructure. These systems can optimize heating, cooling, lighting, and other energy-intensive processes, reducing energy use and associated emissions. Smart grids, which integrate renewable energy sources and manage electricity distribution, also rely on computer science for their operation.

## . Citizen Science and Public Engagement

### --> Environmental Apps

Mobile applications enable citizens to participate in environmental monitoring and conservation efforts. Apps can be used to report pollution incidents, track wildlife sightings, and monitor air quality. This crowdsourced data supplements official monitoring efforts and raises public awareness about environmental issues.

### --> Social Media and Awareness Campaigns

Social media platforms are powerful tools for raising awareness about environmental issues and mobilizing public action. Computer science techniques such as data mining and sentiment analysis can analyze social media data to gauge public opinion on environmental policies and campaigns. This information helps organizations design more effective communication strategies.



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QUESTION:2--> Taking measures to reduce the losses brought by natural disasters has been a major challenge for the world in achieving its development goals. What are the applications of Geographic Information Systems (GIS) and Remote Sensing in Disaster & Emergency Management?

ANSWER:

Natural disasters, such as earthquakes, hurricanes, floods, and wildfires, have devastating impacts on human lives, property, and the environment. Managing these disasters effectively requires accurate and timely information. Geographic Information Systems (GIS) and Remote Sensing are powerful technologies that provide critical information for disaster and emergency management. They enable the collection, analysis, and visualization of spatial data, which is essential for understanding, mitigating, and responding to natural disasters.

## . Applications of GIS in Disaster and Emergency Management

### --> 1. Hazard Mapping and Risk Assessment\*\*

GIS is extensively used in creating hazard maps, which illustrate areas that are susceptible to natural disasters. By integrating various data layers such as topography, land use, soil types, and historical disaster events, GIS helps identify regions at risk. For example:

- Earthquake Hazard Maps: These maps show seismic zones, fault lines, and ground shaking intensities.
- Flood Risk Maps: GIS can model floodplains and predict flood extents based on hydrological data and terrain models.
- Wildfire Risk Maps: These maps highlight areas prone to wildfires based on vegetation types, weather conditions, and historical fire data.

Risk assessment involves analyzing the potential impact of disasters on populations, infrastructure, and the economy. GIS supports this by providing spatial analysis tools that can estimate the extent of damage and identify vulnerable communities.

### --> 2. Disaster Preparedness and Planning\*\*

Effective disaster preparedness involves planning and implementing strategies to minimize the impact of disasters. GIS aids in:

- Evacuation Planning: By analyzing transportation networks and population density, GIS helps design efficient evacuation routes and shelters.
- Resource Allocation: GIS assists in identifying the optimal locations for emergency resources such as hospitals, fire stations, and relief centers.
- Training and Simulations:\*\* GIS-based simulations of disaster scenarios enable emergency responders to practice and refine their response plans.

### --> 3. Early Warning Systems

Early warning systems are critical for reducing the loss of life and property during disasters. GIS plays a key role in:

- >Data Integration: Combining real-time data from various sources such as weather stations, satellites, and sensors, GIS provides a comprehensive view of emerging threats.
- Alert Dissemination: GIS enables the distribution of early warnings to affected populations through various channels such as mobile apps, social media, and public announcements.

## 4. Emergency Response

During a disaster, quick and coordinated response is essential. GIS facilitates:

- Incident Mapping: Real-time mapping of disaster incidents helps track the extent and severity of the event.
- Resource Deployment: GIS supports the allocation and tracking of emergency resources such as rescue teams, medical supplies, and relief materials.
- Situation Awareness: By providing up-to-date information on the disaster situation, GIS helps responders make informed decisions and coordinate their efforts effectively.

## 5. Damage Assessment and Recovery

Post-disaster, assessing the damage and planning for recovery are crucial steps. GIS assists in:

- **Damage Mapping:** High-resolution satellite images and aerial photographs are used to assess the extent of damage to buildings, infrastructure, and the environment.
- **Recovery Planning:** GIS helps identify priority areas for recovery efforts, such as rebuilding infrastructure, restoring services, and providing aid to affected communities.
- **Monitoring and Evaluation:** GIS-based monitoring systems track the progress of recovery activities and evaluate their effectiveness.

## . Applications of Remote Sensing in Disaster and Emergency Management

### 1. Disaster Monitoring and Detection

Remote sensing involves the use of satellite and aerial imagery to monitor and detect natural disasters.

Key applications include:

- **Weather Monitoring:** Satellites equipped with sensors such as those in the GOES (Geostationary Operational Environmental Satellites) series provide continuous weather monitoring, which is essential for predicting and tracking hurricanes, storms, and other weather-related disasters.
- **Flood Detection:** Synthetic Aperture Radar (SAR) sensors on satellites like Sentinel-1 can penetrate cloud cover and provide accurate flood maps, even during heavy rains.
- **Wildfire Detection:** Thermal sensors on satellites such as MODIS (Moderate Resolution Imaging Spectroradiometer) detect hotspots and monitor wildfire spread in real-time.

### 2. Damage Assessment\*\*

Post-disaster damage assessment is crucial for effective response and recovery. Remote sensing provides:

- **Rapid Assessment:\*\*** High-resolution satellite images captured immediately after a disaster provide an overview of the damage extent. For example, the use of imagery from the WorldView-3 satellite can quickly assess earthquake damage in urban areas.
- **Detailed Analysis:** By comparing pre- and post-disaster images, remote sensing helps identify damaged structures, blocked roads, and affected areas.

### 3. Environmental Monitoring

Natural disasters often lead to significant environmental changes. Remote sensing supports:

- **Landslide Monitoring:** Satellite images and LiDAR (Light Detection and Ranging) data are used to monitor landslides and identify areas at risk.
- **Coastal Erosion:** Remote sensing helps track coastal changes due to storms and sea-level rise, providing valuable information for coastal management.
- **Vegetation Health:** Sensors like NDVI (Normalized Difference Vegetation Index) monitor vegetation health and assess the impact of droughts, wildfires, and other disasters on ecosystems.

### 4. Infrastructure Monitoring

Critical infrastructure such as roads, bridges, and power lines are often impacted by natural disasters.

Remote sensing aids in:

- **Damage Detection:** High-resolution imagery and radar data help identify damaged infrastructure and prioritize repairs.
- **Resilience Planning:** By monitoring infrastructure over time, remote sensing provides insights into areas that require strengthening to withstand future disasters.

### 5. Disaster Prediction and Modeling

Remote sensing data is integral to disaster prediction and modeling efforts. Applications include:

- **Weather Prediction:** Satellites provide data on atmospheric conditions, sea surface temperatures, and cloud formations, which are used in weather prediction models.
- **Flood Modeling:** Remote sensing data on rainfall, soil moisture, and topography feed into hydrological models that predict flood extents and timings.

- Seismic Monitoring: Satellites equipped with INSAR (Interferometric Synthetic Aperture Radar) detect ground movements that precede earthquakes, contributing to seismic hazard models.

## . Integration of GIS and Remote Sensing

The integration of GIS and remote sensing enhances their capabilities in disaster and emergency management. Key benefits include:

- Data Integration: GIS integrates remote sensing data with other spatial data such as demographic information, land use, and infrastructure maps, providing a comprehensive view of disaster impacts.

- Improved Accuracy: The combination of high-resolution imagery from remote sensing and spatial analysis tools in GIS improves the accuracy of hazard maps, risk assessments, and damage assessments.

- Real-Time Analysis: The integration enables real-time monitoring and analysis of disaster events, facilitating quicker and more informed decision-making.

- Enhanced Visualization: GIS visualization tools transform remote sensing data into easily interpretable maps and dashboards, aiding communication and understanding among stakeholders.

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