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Rain Disaster Management through Novel Approach of Data Science Utilizing Python as a Programming Language

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Abstract – The impact of flooding is the world's most significant disasters. Over half of destruction from global floods occurs in Asia. Flood causes are because of natural factors like rainfall, flooding & tides, & human factors like channel blockage or excessive use, headwater deforestation, etc. Floods lead to loss of life & property damage. Increasing population results in more urbanization, more impermeable, less erosion, & higher peak & runoff floods. Issues are becoming more urgent because of more serious & regular flooding possibly caused by climate change, socio-economic damage, impacted population, public outrage & limited funds. Prevention & mitigation of flood damage include structural flood control measures such as dam or river dikes construction & non-structural measures such as flood prediction & warning, flood hazard & risk management, community engagement & organizational structure, etc. This paper describes principles, strategies, plans & procedures for integrated disaster & risk management in urban floods. In most developing countries, government flood disaster management (DM) activities are very limited involvement of non-governmental agencies & private sectors. Reactive to enhance management efficiency & reduce life & property losses. Proactive DM requires more involvement from different governments, non-governmental & private agencies, & public involvement. Its time, more budget, more equipment, facilities & human resources, resulting in integration of flood DM for both long-term & short-term activities. Tools for efficient data manipulation & analysis have become significant for (training) & statistics with Data Science as a recent trend. Programming language of Python begins most popular data analysis tools, replacing in many cases. We report on a short case study utilizing Python on basic statistical assessment of real-world air quality data.

Keywords: Flood Plains, Global Warming, Precipitation, Natural Hazard, Data Science, Python, Statistics, Software.

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I. INTRODUCTION

Over years, frequency & intensity of flooding has increased in country largely because of an increased invasion of flood plains. Ironically, while flooding has declined over past decade, re has been a substantial increase in several displaced populations & economic loss. Such developments require better preparedness at federal, regional & local levels to ensure that adequate & efficient action is taken while flood emergency & property. In India, about 75% of total rainfall is distributed over 4 months of monsoon (June–September) & as a result, almost all rivers carry heavy rainfall discharge while these four months Approximately 12 percent of land area of country is prone to flooding, that means about 40 million hectares are prone to flooding & flooding affects million per year. But late floods in states of Gujarat have also become a serious affair. Every year, more than 30 million people are displaced. Recognizing need for hour, 1990-99 decade was proclaimed with main goal of concentrating on DM strategies for prevention, reduction, mitigation, preparedness& response to a property because of natural disasters. [1]

The vulnerability of India is highlighted by fact that 40 million hectares are prone to flooding from a geographic area of 328 million hectares. On average, 75 lakh hectares of & are damaged each year, 1600 lives are lost & damage to crops, houses & infrastructure is about Rs.2000 crores because of flooding. In 1977 maximum number of lives was lost (11,316). frequency of major floods in five years is more than once. Floods have occurred in areas not previously considered to be prone to flooding. Precipitation falls from June to September was 88% in bear from catchments high sediment load. These factors, coupled with insufficient river carrying capacity, are responsible for flooding, drainage congestion is that some of India's damaging rivers originate in neighboring countries, adding to problem complex dimension. This paper reviews existing procedures status of flood management & preparedness in India. [2]

Most towns & urban areas are situated in flood plains because of fertile & flat & that is ideal for farming & urban development. Rivers provide water for domestic, industrial & agricultural use, as well as convenient means of navigation, transportation & communication. Cities have a large percentage of impermeable areas preventing successful precipitation penetration into soil. It causes large rainfall & high flood rates as shown to contribute to flood damage & major flood damage & when exposed for years urban areas. Flooding because of locally heavy rainfall can be categorized as rivers, floods because of overbank flow & flood because of high tides or storm surges. River overbank flow floods occur when level of the river rises above banks of the river. Usually, elevated river levels are caused by high upstream & backwater effects of high tides at mouth of a river. City building in floodplains increases floodplain storage & flooding in floodplains, utilizing even worse flood damage. Because to high flood levels, flood drains in towns can be breached & cause severe flood damage. Cities are usually situated in low lying areas where drainage is difficult without pumping. High tides or storm surges of floods into sea & cause prolonged flooding with polluted floodwater & urban health issues. Climate change impacts increase heavy precipitation, extreme & recurrent floods that are harder to forecast that should consider not only hydraulic & engineering aspects, but also socio-economic & environmental aspects, to have effective flood control & flood risk management. Various actors should be interested in flood prevention, including relevant authorities such as urban planners, civil & water resources experts, civil disaster response authorities, health & social services, etc. [3]

II. THE OCCURRENCE OF FLOOD IN INDIA

From 1915 to 2015, India faced 649 disasters. A flood with an average of 3 floods per year was triggered by 302 of these 649 occurrences. This accounted for about 47% of total disasters that have occurred in India over past 100 years. Such floods can be categorized into Flash floods, coastal flooding & or flood forms. An alarming picture is characterized by decadal flood change in India. Looking at flood trends based on CRED data, we find that India has witnessed a steady rise in flood disasters over past five decades. Floods rose from an average of 1000 per year in decade of 1965-75 to 1700 per year in decade of 2005-15. Over past decade, i.e. 2005-2015, cumulative economic loss was nearly 2 percent of India's current GDP. Compared to last decade's previous decadal failure, it indicates a steep rise in flood-induced economic burden. Among USD 11.6 billion in 1995-2005 to USD 34.5 billion in 2005-2015, economic burden burgeoned. This is because only in last five years most affected five floods occurred. Uttarakhand & Flood (2013), Leh-ladakh Flood (2010), Assam Flood (2012), Jammu Kashmir Flood (2014) & Manipur Flood (2015) are some of largest floods in the world. [4]

III. FLOOD PREPAREDNESS

Floods, that are a natural hazard, do not need to become a disaster if we are prepared & know-how. This would decrease loss of life & minimize suffering of people. This guide lists simple things that you can do to stay safe from floods. [5]

A. Before flooding occurs

- It is necessary to know about the route to the nearest safe shelters.
- First aid kit should be ready for snakebite & diarrhea with additional medication.
- Good ropes for tying things should be available.
- It is significant to arrange a radio, torch & spare batteries.
- It is necessary to store freshwater, dry food, matchbox, kerosene, etc.
- To protect against snakes, umbrellas & bamboo sticks are also necessary.
- The higher ground should be chosen to stay where humans & animals can take shelter. [6]

B. After hearing a flood warning

- Flood warning & guidance on radio & television can be easily obtained.
- Local authorities must keep a watchful eye on flood warning.
- Secure food & drinking water & warm clothing is made ready for use.
- It is necessary to check emergency kit.

C. At the time of evacuation

- Bag of necessary medications, valuables, personal documents, etc. in waterproof bags for safe shelter.
- Replace chairs, bed & table appliances.

- Place for toilet & plug all drain holes to avoid the backflow of wastewater.
- Do not enter unknown depth & current water.
- Lock your house & known evacuation routes for your safe shelter area. [7]

D. While Floods

- It is necessary to use boiled water or halogen tablets to purify water.
- It is best to cover food.
- It is not allowed for children to remain on an empty stomach.
- Bleaching powder & lime should be used for cleaning hands.
- It is possible to prevent entry into floodwaters.
- If one needs to enter n proper footwear may be used.
- It is possible to avoid water over knee level.

E. After a Flood

- Local radio must be in touch.
- Children should not play in floodwaters or near areas of a flood.
- It's necessary to stay away from drains, corners.
- There should be no use of electrical appliances.
- Food must be protected from floodwaters.
- Before using water for drinking purposes, it should be boiled.
- One can have halogen tablets before drinking water.
- Snake bites must be cautious, snakebites are common in floods. [8]

IV. BROAD CATEGORY OF TASKS CONCERNING NATURAL DISASTERS

Large categories of tasks that can be solved utilizing various data types have been addressed in this section. goals of activities can be categorized in following three main categories:

1. **Prediction: S**ets of tasks include prediction of natural disaster, disaster-prone region, & various characteristics of a possible natural disaster. Essentially, or activities include anticipating or projecting disaster's time, place & severity.

2. **Detection:** Sets of tasks involve detecting natural disaster as soon as it occurs. Literature studies show that social sensors record a natural disaster much faster than observatories in terms of tweets, or social media websites. [9]

3. **DM Strategies:** Methods deal with identification of various entities involved in fight against a disaster to enhance communication, identify appropriate concerns of affected people & optimize distribution of relief items.

Another branch of study deals with psychological & behavioral changes following disaster over affected regions. The classification is overlapping in many cases. It can certainly be argued as an example that detecting natural disasters will help in strategies for DM. Even psychological studies can provide a great deal of insight into strategies for DM. This category is before based on a direct objective of task involved. re are some rare cases that fall in a borderline. [10]

Prediction: This is the most "ideal" problem to solve would be but very often, with available data & techniques, this is not a problem that can be solved. Furthermore, areas vulnerable to a specific type of disaster, let's say, or flood can be predicted. It has been seen that forecasting methods are more effective in predicting different characteristics of a natural disaster that has occurred. These methods can be used as an example to predict strength of a cyclone's earthquake, monitor & frequency, etc. For such tasks, it is often necessary to analyze different spatial & temporal data. Even though researchers have focused on these issues. [11]

Detection: meteorological observatories often detect natural disasters, but detection news takes a long time to communicate exact location of detection to appropriate authorities.

DM Strategies: These sets of tasks are involved in development of appropriate strategies for DM. An example of such tasks is an identification of critical DM entities; identification of appropriate communication study, identifying needs of the disaster-affected area. In these tasks, social media data is very significant. The goal of DM should be following:

- Minimize casualties

- Rescue victims on time
- Instantly offer first aid
- Evacuate people & animals to safe places
- Rebuild damage immediately. [12]

V. MAJOR DATA SOURCES

There is no definition of "big data" in DM to best of these researchers. A report by Federal Geographic Data Committee (FGDC) analyzed new data sets, including real-time Spatio-temporal data (e.g. GPS data), increased involvement (e.g., voluntary geographic information & social media), small satellites, & unmanned aircraft vehicles (UAVs). A United Nations (UN) study highlighted examples of large data sources in disaster resilience, including exhaust data (mobile, financial transactions, transportation, electronic traces), digital content (social media & crowd-sourcing), & sensing data (physical sensing & remote sensing devices).In this paper, we define big data as an integration of various data sources & ability to analyze & use data (usually in real-time) to benefit population involved in a situation of disaster. [13]

1. Satellite Imagery

Remote sensing technology from satellites provides qualitative & quantitative opportunities in context of various functions such as assessing post-disaster damage, responding through operational assistance & reducing risk. Post-disaster damage assessment through change detection is most remarkable contribution of remote sensing imaging. Utilizing approaches such as higher resolution, multidimensional, & multi-technique, remote sensing is used in DM. The recently developed high-resolution satellite imagery facilitates collection of detailed texture information for change detection before & after a natural disaster. Such information is critical to achieving after disasters occur. Information through high-resolution satellite imagery may relate to land area structural deformation, directional changes & water bodies creation, & details of damaged building stock in an area affected by a disaster. Rescue methods can before be suggested & initiated by utilizing high-resolution remote sensing techniques for immediate location & recovery of bereaved persons & for accurate location of corresponding area. In addition to two-dimensional information, three-dimensional images can also be generated in form of a stereo image along with height information.

Three-dimensional mapping allows identification of collapsed buildings & damaged regions by measuring variations in building height & calculating piled-up debris heights & volumes with use of stereo object pairs pre-& post-disaster. To address limitations of optical satellite imagery in cloud cover, rain conditions, & at night time, active sensors such as syntactic aperture radar (SAR) can be used effectively to increase their observational capacity while a natural disaster. Given detection of impacts or changes caused by disasters, satellite imagery was intensively used to reduce risk of disasters, including identification of human settlements, assessing flood & reduction risk.[14]

2. UAV-Based Aerial Imagery & Videos.

Thanks to its usefulness in situational awareness, aerial imagery collected by unmanned aerial vehicles (UAVs) is playing a significant role in disaster response. With a high spatial resolution, aerial imagery can be recorded & processed much faster than satellite imagery. UAVs offer additional benefits in addition to improvements provided by oblique imagery gained from piloted platforms. These include fully controlled flight, VHR imagery with a resolution of up to 2 cm that allows fine cracks to be detected, & a large degree of image overlap that allows very detailed point clouds to be produced. Utilizing UAVs, first responders can access structures that have been affected by a given event & can determine extent of damage that has been caused. UAVs can carry different sensor types including cameras, audio, infrared & ultraviolet sensors, radiation sensors, wear sensors, spectrum analyzers, & refectory LIDAR. UAV imagery & video mapping provide real-time, detailed situation information to traffic planners surveying damaged highways, evacuation routes, & transport logistics support UAVs are now known as a credible source of data for information about disasters & to boost damage assessment scale. It is possible to identify façade & roof damage to buildings by combining structural transformation & environmental information with a combined use of UAV imagery, satellite & aircraft data. combination of UAV & crowd-sourcing allows for annotation in context of features of interest, such as damaged shelters& roads blocked by debris.[15]

3. Wireless Sensor Web & Internet of Things

To develop an early warning system for natural disasters, utilizing latest Wireless Sensor Network (WSN) technologies. WSN systems provide reliable data transfer & integrate heterogeneous sensor data fusion & reduce energy consumption. The reviewed overall structure of WSN & UAV systems for natural disasters suggested Monitoring & Alarm Technology in a Network of Systems to integrate mobile information with WSN to improve awareness of situation. Integrated low-cost embedded systems based on WSN & UAVs in critical situations to increase response time, reduce latency & optimize delivery performance. WSN was also commonly used to promote intercommunication among a disaster-affected community & rescue teams when conventional communication network systems fail. Utilizing a team of mobile robots to explore an unfamiliar area after a catastrophe, WSN widened scope of interaction for detection of human existence. In terms of overall integration of heterogeneous data sources & protocols from "socio-techno-economic viewpoints," WSN is widely deployed. WSN relates to Internet of Things (IoT) technology as an essential component. Many IoT-enabled DM systems were evaluated, including BRINCO (Earthquake & Tsunami Warning Notification System), BRCK (Low Connectivity Communication System) & GRILLO (Earthquake Alarming Sensor Network). IoT's advantages include its ability to compensate for a vulnerable population's poor infrastructure, particularly in developing countries, & being an alternative means of communication where IoT-enabled devices (battery-powered wireless devices) can use data network resilience in disaster situations.[16]

4. LiDAR

Airborne & terrestrial light detection & ranging (LiDAR) is a method that provides ability to extract high-quality elevation models & or characteristics, providing reliable on-ground information while a disaster. LiDAR equipment is relatively expensive & it can often prove time-consuming to obtain & process data. DEMs produced from LiDAR data, however, can have a very high resolution & are very accurate. LiDAR scanners, unlike aerial photography, collect data at a very fine (centimeter) scale resolution & can collect information below vegetation on ground surface. This skill is very useful for geological mapping & geological calculation, including tracking growth of volcanoes & predicting patterns of an eruption. LiDAR information is also highly sensitive to water & thus proves to be an effective source of data for forecasting & assessing floods. LiDAR is useful in detection & assessment of changes in altitude or structural damage following natural disasters. For example, Kwan & demonstrated use & analysis of LiDAR data before & after Hurricane Katrina while a disaster response in detecting traffic network obstacles. They also showed how data helped to reduce time taken to reach disaster sites by first responders. Likewise, after an earthquake that hit Kumamoto, Japan on April 16, 2016, buildings collapsed. They achieved so with use of virtual surface models (DSMs), taken while LiDAR flights before & after an earthquake. [17]

5. Simulation Data

Numerical simulation or forecasting is one of most significant contributions to natural disaster prediction because of meteorological phenomena, land surface phenomena & various types of pollution. However, 3D modeling was useful in assessing potential damage & in analyzing changes that occur after a disaster. While natural disasters, large amounts of different types of observation data are generated & these data can be used to create, check, validate, & improve model store address challenge for all aspects. Utilizing available high-resolution data, agent-based models are ideal to investigate human behavior & rapid low-level environmental changes. Developed an agent-based system to test a contingency plan for human rescue operations in a disaster. The collected data method from remote sensing images of high resolution simulates an environment based on a three-dimensional geological model, & uses a multi-agent simulation approach to simulate individual behavior in complex disaster scenarios.

simulations have positive effects, e.g. speeding up process & reducing a number of injuries, on evacuation process. Case studies in Indonesia, Japan reviewed models for tsunami mitigation & evacuation preparation. Used advanced by integrating agent-based models with physical sensors, & controlled heterogeneous data asset collection & agent-based models to build what-if scenarios to discourage best course of action. [18]

6. Vector-Based Spatial Data

Vector-based spatial data provides fundamental support for DM, including disaster forecasts about extent of a particular hazard or disaster, vulnerability analysis for critical facilities (hospital, school, shelter etc.) & human beings (age, gender, socioeconomic status, etc.), damage assessment on actual impact of a hazard, resource inventory (supplies, equipment, vehicles, etc.), & infrastructure (transportation networks & utility grids). Reviewed value of GIS & major disaster response data sources, including Federal Emergency Management Agency (FEMA) GIS Information Feeds, US Census Bureau TIGER, National Map, World Bank Information, & Open Street Map. Herold & Sawada reviewed DM software for GIS, highlighting developing countries.[19]

7. Crowd sourcing

The public contributes to both crowd sourcing & social media information. While crowd sourcing data is actively contributed, social media data is mostly contributed passively, as contributors are not aware that social media activities lead to data collection. Effective crowd sourcing systems have been developed to provide users with knowledge they need enthusiastically. Typically, these networks are developed & implemented by representatives of affected communities or NGOs such as Usha hidi. These tools are proposed to improve disaster response & resource allocation based on disaster real-time data. With many success stories, challenges of utilizing effective crowd sourcing systems are still worth considering, especially concerning legitimacy & quality of incorporating crowd-based information into decision-making process. Because of its noisy nature, large volume, & fast streaming speed, analysis & processing of crowd-based disaster data requires varied tools & automation processes. In line with location of disaster area & data analyzed, significance of crowd-sourced data can be ordered. To collect & distribute crowd-based information while& after disasters, online platforms & mobile applications have been developed. Dos Santos Rocha discussed techniques that disaster managers should follow to boost online volunteer quality. They also assert that crowd sensing & interactive mapping can be used in distributed intelligence, participatory participation, & self-mobilization functions. They recommended adoption among stakeholders of a feedback mechanism to improve interaction effectiveness. [20]

8. Social Media

Social media platforms have made a significant contribution to DM, including Facebook, Youtube, Foursquare, & Flickr. It is possible to collect geotagged social media data by streaming harvest from social media companies ' APIs. Social media services have made a significant contribution to DM as a medium for DM to share information. All NGOs &government agencies for DM are continuously utilizing social media to assess public sentiment & response to an occurrence. Multidirectional communication & knowledge flows that crises enable online crowd sourcing platforms will make efforts to respond & recover more effective. While social media offers tacit crowd sourced information varieties, it is used effectively in management of disasters. Granell & Ostermann addressed Twitter being more effective in detecting & predicting & less significant in functions of recovery & response. Strong evidence of current situation in affected area while post-disaster periods can be generated by or data sources such as spatial imagery, UAV, & phone call data.

There are a variety of ways to use social media in DM, including data collection, analytical workflow, narrative creation, disaster-related information processing, geo-location pattern/text/ image analysis, & social media platform broadcasting of knowledge. Several authors have shown that social media-based real-time analytics offer good opportunities for automatically detecting & tracking events. Text messages are basic origin of research. Visual analytics through social media data promote Spatio-temporal analysis & create an environment that facilitates spatial decision-making that assists in preparation for evacuation & DM. Since social media is not relying solely on text messages & offering more useful information by user-posted images & videos, visual analysis & image / video-based research are nowadays more significant in extracting key information from social media posts.[21]

9. Mobile GPS & Call Data Record

Mobile GPS (Global Positioning System) has emerged as an effective means of mobile sensing information as it can be used to track human movement & activity in natural disasters on a large scale. Horanont used data collected after 2011 Great Japan Earthquake & provided useful information on how to respond in disaster scenarios & how to track evacuation processes in real-time. With GPS, location, magnitude, & or details of an earthquake fault can be determined. This is done by utilizing one or more of three basic GPS components that are absolute location, relative movement, & transmission of time. GPS data helps to measure automatically l2ocation, magnitude or details of fault of an earthquake. Likewise, after Great East Japan Earthquake & Fukushima nuclear accident, Song developed a human mobility model to determine people's DM attitudes & mobility patterns. We find that human behavior & flexibility after major disasters also resemble with their mobility.[22]

VI. DATA SCIENCE & PYTHON

Finding an objective way to evaluate popularity of some concept is difficult. To evaluate success of search query "Data Science" among December 2012 & November 2017, we try utilizing Google Trends tool. Figure 1 is a visualization of data from that it was obtained & it represents a relative interest in Google search engine search query compared to highest value in time series (value 100 is highest popularity). Clearly, in recent years, "Data Science" has gained popularity very quickly.[23]

definition of data science, that has recently begun to be used much more commonly than before, may still lack its precise meaning, but it often applies to parallel computing, managing data formats (such as access log files, e-mail messages), data technologies such as XML, JSON, web scraping, NoSQL database technologies (including Map Reduce, Key quality database systems or graphics). [24]

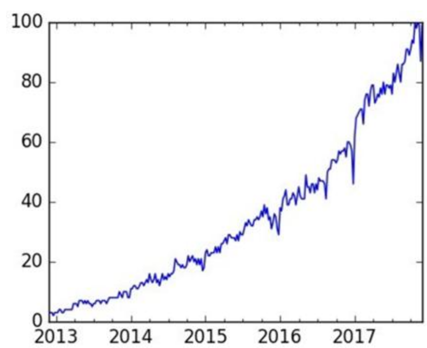

Fig. 1. "Data Science" query popularity over time in Google Trends.

VII. PYTHON PROGRAMMING LANGUAGE & STATISTICS

Python programming language is one of most often used languages today & it has the following basic features:

- Open-source software
- Interpreted language
- General-purpose language
- There exist many extension packages designed for specific needs
- Quite easy to learn

Google Trends tool states "python for data science" as a top related query for "data science" query. Often used for data analysis, visualization, & numerical computing, Python extension packages include SciPy, & seaborn. In data analysis & even in high-performance computing, re are many articles promoting the use of Python.[25]

CONCLUSION

Natural disasters in earthquake forms, floods, AER6storms destroy multiple lives, resulting in -substantial property damage. In a developing country like India, results were much more extreme than in developed countries. Many efforts have been made to predict disasters based on different data sources. We explore multidisciplinary nature of task, where data mining models are applied to different data types, requiring profound expertise in subject matter. As a significant source of information, social media & Internet have also emerged recently. Such sources may not be used for disaster forecasting, but y have made a significant contribution to early detection & acceptance for an adequate response to disasters. We observe that not enough work in this area has been done to exploit potential of the sources, particularly in India context.

Flood in India has become one of biggest disasters in recent years that have killed thousands of people. Throughout time, recurrence & frequency has increased, which has caused significant harm to life & economy. The government has taken several steps to reduce flood damage & or hazards, but a long way to go. To minimize devastations, use of science & technology, telecommunications & media for alarming &pre-disaster measures can be successful. It can also be an effective measure to minimize damage to set up an alarming device on banks of rivers that can warn neighboring dwellers about rising water levels. Along with it, awareness campaigns & flood-affected area preparedness plan will help to reduce losses. surrounding community's relocation to a healthy & safer place before flooding will reduce risk to life. Quick action in provision of goods & services such as medicine, food & water supply helps to recover quickly after disaster & to reduce losses. Analysis of flood trend & damage it causes suggests that effective pre-& post-disaster mechanisms are needed as nature cannot be controlled but disaster can be reduced.

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