THE ROLE OF ICT IN DISASTER MANAGEMENT IN MAHARASHTRA: CHALLENGES & OPPORTUNITIES

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ABSTRACT

The green planet is endangered due to several natural as well as man-made disasters caused from time to time. The climate change, increasing population, heavy rainfall, poor infrastructure, lack of high-end technology are the major challenges existing in disaster management in India and Maharashtra respectively. The natural disasters are generally volatile, uncertain, complex and ambiguous in nature. They cause numerous deaths of people as well as huge economic losses in the long-term. Naturally, there is a crucial need for effective disaster management plan. The use of ICT is a proactive approach. The flood situation in Western Maharashtra occurred in October, 2020 proved it dangerous raising the question mark on the governance and effectiveness of disaster management. The information and communication technology can minimize the challenges in disaster management and empower the individuals, agencies, government authorities and other stakeholders to understand red-alarm situation and take preventive measures. The present study aims to analyze the role of information and communication technologies such as satellite communication, mobile applications, social media and other exclusive systems and software for effective disaster management in Maharashtra. Right from preparedness to prevention

Keywords: Information and Communication Technology (ICT), Disaster Management, VUCA Model

Introduction

The human life is full of ups and down. Human beings are part of nature. However, the human interference in natural activities invite more risks and create complexities arising out of greed, competition, selfishness etc. Maharashtra is considered to be one of the progressive states in India. However, it has witnessed a series of challenges in the forms of man-made as well as natural disasters between 2000 and 2020. There are multiple vulnerable factors causing the disasters in Maharashtra. Overcrowded population, stress on natural resources, deforestation, pollution are man-made factors while drought, cyclones, tsunami, landslide, flood, fire, earthquake are natural factors (Wagle&Warghade, 2006). Together, they disturb the ecosystem. The disasters are harmful posing the threat to the loss of human life as well as socio-economic stress on individuals, societies, government and other stakeholders. The volatility, uncertainty, complexity and ambiguity make disaster management process more challenging (Mitra, 2006). The information and communication technology (ICT) can play a significant role in risk mitigation and effective disaster management (ITU, 2019). The present study aims to analyze the contribution of ICT in disaster management in the state of Maharashtra from sustainability perspective.

Scope & Significance of Study:

The United Nations Organization (UNO) has introduced the 17 Sustainable Development Goals (SDGs) to save green planet from the disasters. It has appealed to various national governments to align their policy frameworks with SDGs. The term 'sustainable development' has gained the momentum in the 21st century when environmental awareness has increased, eco-friendly products, green campuses are encouraged. It is expected that People, Planet and Profits should be taken care of in the descending order of priority. The exploitation of resources may attract huge risks causing disasters. Hence, the preventive and proactive approach is significant than corrective approach. The communication, coordination, education, evaluation and effectiveness of disaster management strategies have to be reviewed keeping the changing nature of disasters in mind. The user-friendly, techno-driven, automated, scientific, interactive and informative disaster management system can meet the diverse requirements of people from time to time (Kafi&Gibril, 2016).

1.   Objectives of Study

a. To study the disaster management trends in Maharashtra

b. To conceptualize the information and communication technology trends in disaster management

c. To identify the major challenges in disaster management in Maharashtra and India

d. To examine the role of ICT in planning and implementation of disaster management

e. To analyze the effectiveness of Maharashtra Government in disaster management planning and execution

f. To provide feasible solutions for better disaster management

2.   Problem Statement

Though Maharashtra is considered to be one of the progressive states in India, the some of the past incidents have proved how the disaster management failed causing the lives of people and financial damage to the victims. Therefore, the present seeks the answers to the questions: "What is the role of information and communication technology in disaster management? How can it help to minimize the challenges and improve the overall efficiency in disaster management in Maharashtra?"

3.   Review of Literature

The various research studies have found that Maharashtra has been facing the major challenge of recurring drought since several decades. It has long-term and severed impact on the socio-economic conditions of farmers.The rain-fed cropping system of agriculture causes huge losses creating uncertainties and financial instabilities in Maharashtra (Hingmire, 2021). The natural disasters are uncertain and complex in nature. The developed nations like United States of America, United Kingdom and other leading countries have designed and developed better technologies to understand the indications, implications to get real time updates and prepare for the same (Sharma, 2001). However, a developing nation like India has a long way to design, develop technology and adopt innovative methods, techniques. The condition of India is reflected in the states too.

The Comptroller and Auditor General (CAG) audit report published in 2019 clearly questioned the performance of disaster management for Pune division. The flaws were found on multiple grounds such as lack of communication, absence of coordination, missing updates on rain alert, faulty preparedness policies etc. Moreover, the social activities from Pune, Satara, Sangli and Kolhapur districts opined that the disaster management policies were prepared and remained on the paper only. Mr. VivekVelankar (A social activist from Pune) asserted that the disaster management cell is as good as a white elephant.

The climate change is one of the major hindrances in the process of natural disaster management in India and Maharashtra respectively. It has created multi-level implications in the rainfall, drastic changes in the routine, low pressure belt, sudden arrival of snowfall etc. (Gazette of India, 2005). The frequency and intensity of floods,droughts, landslides, cyclones and storms have increased on a large scale causing disasters to human mankind, environment, and agriculture also (World Bank, 2000). It is likely to continue in future since the stress on natural resources is also increased on consistent basis. The rising levels of sea, rivers and sudden flow of water from dams have led to catastrophic results for both urban and rural residents of Maharashtra state.

The faulty government policies, incompetent workforce, poor infrastructure, outdate technology have a great deal of contribution in creating volatility, uncertainty, complexity and ambiguity in disaster management not only in Maharashtra but also in India (Chakrabarti, 2011). This is because the state and district disaster management plans are prepared based on the national policies and frameworks. It is unfortunate that the central and state government authorities have not succeeded in tracking the real-time updates. The gap amongst various government departments exists. The policies and beneficiaries are trapped in red-tapism and have to wait for several years to get the financial assistance (United Nations, 2019). In addition, the criteria keep on changing from time to time. There must a meticulous planning and effective implementation at pre, during and post-disaster management stages. Helping the vulnerable segments of society (disabled, women, senior citizens, children, poor etc.) should be the top

priority. The follies exist in preparedness, response, recovery and reconstruction levels to. According to Rathore (2016), the technology has influenced the personal, professional and public life in the digital age. It can serve as a tool to overcome the various challenges existing in disaster management. Some of the major areas of ICT intervention could be weather forecasting, risk identification and mitigation, satellite communication, remote sensing, GIS, zone mapping, resource utilization etc.

In a research done by Gandhigram Rural University (2008), outdated technology, language barriers, lack of innovation, limited call centres, poor internet connectivity, absence of electricity, documentation formalities are found to be the key reasons responsible for the inefficiency in disaster management process. The various routers, browsers, applications, systems have to capable enough to collect, store and access big data helping in effective decision-making process.

4.   Research Methodology

The research method applied for the present study is the Systematic Literature Reviews (SLR). It is a method used to identify, evaluate, analyze and construe the relevant existing literature. The keywords such as "Disaster Management", "Information and Communication Technology", "ICT in Disaster Management", "Challenges influencing Disaster Management", "Natural Disasters in Maharashtra", "Flood in Western Maharashtra" and "Crisis Management" to collect research articles, working papers, industry reports, case studies etc. from reputable databases like Scopus, IEEExplore, Science Direct, Research Gate and Google Scholar which are relevant and latest with respect to the topic of present study. Total 25 research studies were reviewed. However, 18 were closely relevant to the study. Hence, they are analyzed in-depth. They include doctoral thesis, research papers, government reports, publication series etc.

5.   Systematic Literature Review

Table 1: Summary of Literature Reviewed					
Sr. No.	Year	Author/s	Title	Research Study	Topic Covered
1	2009	Erramilli, B. P.	Disaster Management in India: Analysis of Factors Impacting Capacity Building	Doctoral Thesis	Dense population, climate change, deforestation, increasing urbanization, heavy rainfall cause vulnerabilities; Education, age group, income sources, socio-economic conditions, institutional frameworks, government policies and technology impact on capacity building
1	2014	Zaman. A. &Biswas, A. K. M. A. A.	Application of ICT Tools for Climate Change and Disaster Management in Bangladesh	Research Paper	Use of ICT in disaster management, climate change in Bangladesh; Challenges Faced: Increasing population, insufficient funding, ineffective local governance, food insecurity;
2	2011	Government of India	Disaster Management in India	Report	ICT contributes in Recovery, Reconstruction, Rehabilitation-Social, Economic & Medical; Capacity Development- Training, Education, Research & Awareness
3	2005	Government of India- UNDP Disaster Risk Management Program	ICT for Disaster Risk Reduction: The Indian Experience	Report	Mobilization, allocation of skilled human resources, information dissemination system, Indian Disaster Resource Network-Nationwide electronic inventory (IDRN), GIS-based national database, National Emergency Communication Plan
4	2014	Udmale, P., Ichikawa, Y. & Others	Farmers' perception of drought impacts, local adaptation and administrative mitigation measures in Maharashtra State, India	Research Paper	Need of designing technological and policy interventions for effective drought mitigation and relief in Maharashtra; recurring droughts leads to farmers' suicides, Need for water management education, training programs, raising awareness, financial literacy

5	2016	Govt. of Maharashtra	Maharashtra State Disaster Management Plan	Report	Vision of preparing holistic, proactive, multi-disaster and technology-driven strategy providing integrated solutions and speedy recoveries as per Section 31 of National Disaster Management Act, 200; Incident Response System; Institutional Development (Central-State-District-Block-Local levels); Knowledge management
6	2012	Govt. of India	National Disaster Management Information and Communication System	Book	A paradigm shift in design and development of ICT Network: Disaster-wise (Flood/Cyclone/Earthquake/Landslide etc.), Phase-wise-Mitigation/Preparedness/Response/Recovery; ISRO-based DM Support Network; Police Communication Network (POLNET)
7	2016	Budhiraja, Renu	Country Case Studies in ICT for Disaster Management	Case Studies	ICT Intervention for E-Governance in Disaster Management: Mobile/SMS- Planning, Warning-50% Indian Population use mobile phones; Internet- Structured Communication & Dissemination of information;
8	2018	International Space University, South Australia	Space based Solutions for Developing Nations	Program Report	Collaborative research of 25 participants of 9 countries; Space-based PNT technology position-navigation-timing in DMS; Millimeter Wave Products (MI-Wave); Stratospheric balloons,; the Internet of Soft Robotics
9	2017	Ray, P., Mukherjee, M. and Shu, L.,	Internet of Things for Disaster Management: State-of-the-Art and Prospects	Research Paper	The Internet of Things (IoT) and its usage in database management, image capturing, group decision-making in pre, during and post-disaster management activities
10	2017	Saha, H.,Auddy, S., Pal, S., Kumar, S. & Others	Disaster Management using Internet of Things	Research Paper	Maximizing the scope of automation through the Internet of Things, cloud computing and shared services to update portals, systems in a real-time environment; Decision Support Systems through Critical Path Methods; Just-In-Time supply of medicines, food, shelter
11	2016	Kafi, K.M. and Gibril, M.B.A.,	GPS Application in Disaster Management: A Review	Research Paper	Locating critical points, mapping the zones, aerial surveys of infected areas, rescue operations, emergency communication
12	2019	Bothale, V.M., Khobragade, A. N., Khandare, S.B.&Srivastav, N.T.	Role of Geo-Informatics in Development of Disaster Management Information System	Research Paper	Use of Geo-Informatics in DIMS: Overcoming challenges, vulnerabilities, developing Digital Elevation Model (DEM), created; CARTOSAT-1 data using image processing techniques, sensor model, RPC's Model, Control Points, distribution of GCPs to achieve best results in planimetric as well as in height accuracy; 3-D Visualization; Scalable to other states in India; supporting regional languages like Marathi
13	2018	Nirmala, R.S. & Walter, P.T.	Natural Disasters Management	Research Paper	Increasing population and geo-climatic conditions making Indian regions vulnerable. India is highly proned to floods causing loss of 8 Million hectare land per year along with several deaths. Role of NGOs & technology is significant in disaster management
14	2021	Hingmire, A.	Planning for Disaster Management in India using IOT	Research Paper	Artificial intelligence based technology devices such as drones, embedded sensors and robots for effective disaster management; Machine Learning Tools for trend analysis, predictions, situational analysis

15	2018	Jeong, S. & Yoon, D.K.	Examining Vulnerability Factors to Natural Disasters with a Spatial Autoregressive Model: The Case of South Korea	Research Paper	A Lagrange Multiplier diagnostic test-based spatial autoregressive model; population density, socio-economic factors and geographical conditions influence the ecosystem causing vulnerability; technology can provide better access, timely information, and help in disaster management
16	2016	Rathore, V.	Technology in Disaster Management and Disaster Risk Reduction: A Review of Applications	Research Paper	Technologies used in Risk Reduction phase of Disaster Management: Database Management System, Management Information S, DSS, GIS, Remote Sensing; Scope for Vulnerability, What-if, Task priority, health and safety analysis, Algorithm and reports generation
17	2020	Fontes, L. D. M. & Bello, O.	The Use of Technology and Innovative Approaches in Disaster and Risk Management: A Characterization of Caribbean Countries' Experiences: Studies and Perspectives series	Case Study Series	Hydro-meteorological tools; data collection through Doppler, Radar, Stream-flow and Rainfall gauges as well as automatic weather stations; nuclear technology, social media; use of ICT for insurance, micro finance, community funding, pre and post disaster assessments, Eco-infrastructure
18	2019	United Nations	Climate Finance, Disaster Risk and Environmental Resilience, Inter-Agency Task Force on Financing for Development	Report	Central Databases- Online inventory & emergency contacts; Mobile Apps- regular updates, data management; GIS- DSS, incident mapping, satellite images; Social Media

6.   Discussion & Analysis

Challenges	ICT Tools	ICT Contribution in Disaster Management
Lack of communication	Satellites, Geo-Spatial System	Satellite/Wireless Communication; ISRO-based DM Support Network; Police Communication Network (POLNET)
Coordination gap amongst various government department	Central Database Management System, Servers, Routers	Development of phase-wise modules disaster management (Response, Recovery, Reconstruction, Rehabilitation)
Raising awareness	Social Media (Facebook, WhatsApp etc.)	Creating Community Pages, Groups, Taskforce groups, Quiz etc.
Capacity Building	Mobile Apps, Websites, e-learning platform, IDRN	E-Learning, E-Training to NGOs, Communities, Officers
Unpredictable climate	Digital Elevation Model (DEM), created; CARTOSAT-1	Weather alerts, Warning alarms
Poor infrastructure/ project management	e-Governance	Up-gradation of systems, review of policies etc.
Vulnerable Factors (Volatility, Uncertainty, Complexity and Ambiguity)	Space-based PNT technology position-navigation-timing in DMS; Millimeter Wave Products (MI-Wave); Stratospheric balloons	Risk identification-mitigation; preventive measures in disaster management, Network of Network system
Outdated Technology	Artificial Intelligence, Machine Learning, Internet of Things	Customized module design and development phase-wise, zone-wise, disaster forms (flood/earthquake/cyclone etc.)
Poor decision-making, lack of accountability	Decision Support Systems through Critical Path Methods; Just-In-Time Tools	Tracking real-time progress with turn-around-time (TAT) with high level transparency and accountability at all levels
Reports & Documentation	Online Inventory, Cloud Computing, Central Databases	Dashboards generate & store automated reports
Lack of Innovation and	Hydro-meteorological tools; data	Collaborative research feasible; cases studies,

Research	collection through Doppler, Radar, Stream flow and Rainfall gauge, Nuclear technology	simulations, testing, trend/situation analysis
Lack of funding	Cloud-computing, FinTech,	Corporate Social Responsibility, ICT for Insurance, Micro-finance
Emergency Rescue Operations	Use of soft robotics, drones, sensors	Using robots in high-risk areas, aerial inspections, drone-based supply of food/medicines etc.

7. Findings of Study

The information and communication technology (ICT) has not only brought the comfort in the life of individuals but also helped the organizations, governments and societies to minimize the risks, challenges associated with the natural disasters. There are multiple tools and techniques designed and developed in the form of ICT. The hardware, software, servers, satellites, robotics, sensors, drones, mobile applications, websites, databases, systems and models together perform effectively to achieve the predefined goals as per the Disaster Management Act, 2005. The ICT can contribute in all stages of disaster management process (response, recovery, rehabilitation, reconstruction etc.). In addition, it can integrate the different verticals, systems to collect real-time data, access and convert into meaningful information for effective decision-making saving the lives of people and financial losses too. The customization is feasible to the great extent based on region, type/stage of disaster etc. It is possible to prepare 'Customized software on Damage, Loss and Needs Assessment (DLNA).

8. Conclusion

All of the above discussion shows that the use of ICT is a major step towards sustainable development. It can transform the existing procedures into e-governance improving the transparency, accountability, accessibility, flexibility, safety and security. However, the expertise, budget, infrastructure and willpower are essential equally. The ICT has a significant role in integration, communication, co-ordination, documentation, research and development, policy framework, data-driven decision support systems, automation etc. It serves as a key link amongst the local, district, state and central government authorities, non-governmental organizations (NGOs), communities and other stakeholders. With due care and expertise, it can create win-win situations for Maharashtra and India respectively.

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