Review Paper:

The Sendai Framework for Disaster Risk Reduction and Disaster Management Plan of Indian Railways

Ghosh Sajal Kumar[1]* and Sar Ashok Kumar[2]

1. School of Management, Kalinga Institute of Industrial Technology Deemed to be University, Bhubaneswar, Odisha, INDIA
2. Department of Strategic Management, School of Management, Kalinga Institute of Industrial Technology Deemed to be University, Bhubaneswar, Odisha, INDIA

*1381029@ksom.ac.in: sajal.talcher@gmail.com

Abstract

Sendai Framework for Disaster Risk Reduction 2015-30 (SFDRR) was adopted by United Nations as a global framework for disaster risk reduction and was signed by member countries. It was adopted as a successor of earlier existing Hyogo Framework for Action 2005-2015 to advance a common Disaster Risk Reduction (DRR) policy worldwide. In spite of agreement, on the importance of the SFDRR 2015-30, its low implementation at the local level remains a matter of concern. For a developing country like India, SFDRR is of much importance due to a large population vulnerable to all types of disasters. This study examined the extent to which Indian Railways (IR) being the national transporter of India and used by most of Indians, became able to synchronize and adopt SFDRR into its disaster management plan.

The study discussed the present disaster management plan adopted by Indian Railways and attempted to identify gaps existing in adoption of the Sendai framework in its risk reduction activities. It is concluded that Indian Railway is able to adopt SFDRR priorities to reduce disaster risks in many of its operational activities except areas like railway construction activities where more actions are to be taken to reduce risk of disasters. The findings will be useful to disaster managers in railway sector as well as other institutions to effectively prepare/modify their disaster management plans so that countries can achieve the disaster risk reduction targets fixed in SFDRR.

Keywords: Disaster management plan, Indian Railways, Sendai Framework for Disaster Risk Reduction, SFDRR.

Introduction

The word "Disaster" has its origin in middle French word "*desastre"* derived *from* old Italian word "*disastro*" which was said to be imported from two ancient Greek words "*dus"* (meaning bad) and "*aster"* (meaning bad star). Its meaning was celestial event of destruction of a star[8].

Disasters kill people and damage properties and infrastructures. Disaster may be natural or may be due to some acts of human. From time immortal, mankind is facing disasters in different form with varied magnitude. So disasters always had attracted human attention in both attempting to prevent it and to overcome its repercussions[6]. Due to worldwide rise in loss due to disasters, it had emerged as a threat to the survival of mankind and became a global challenge[21]. To face any challenge, it is imperative to understand it thoroughly. In order to explain disaster, the United Nations office for Disaster Risk Reduction (UNISDR)[19] terms it as "A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources".

Disasters cause harmful effects on human physically, mentally, socially, environmentally and economically. Normally potential hazards change into disasters when the community becomes incapable to handle it. From early days of human civilization, it had faced many natural disasters in form of earthquakes, floods, volcanic eruptions, cyclones, landslides, tsunamis, draughts and epidemics. These natural disasters had caused death of billions of people and in many cases destroyed the whole civilization.

Later, when humankind stepped into its journey of development through scientific and technological advancement, different new disasters started evolving in form of manmade disasters. Environmental changes, terrorist attacks, chemical leakages, fire outbreaks, nuclear accidents use of weapons for mass destruction during war, fire breakouts, technical failures, civilian unrest, structural collapse and transport accidents like train, aero plane and ship accidents. Some are manmade disasters posed as big challenges for mankind. Another classification of disaster is slowly developing and suddenly occurring[5]. Humankind had always tried to overcome these disasters. Not only in earlier days, but also these days, in many civilizations, worship of God is in vogue to overcome the vulnerabilities to natural disasters.

However, with the development of scientific temperament, systematic ways to deal with disasters started developing. A community or an organization, normally is not able to cope with disasters alone, it is necessary to have a co-operation among communities, organizations, governments and countries for management of disasters. Also there is need for adoption of scientific and technological knowledge in

disaster management. There is also need of proper policy and guidelines in managing different kinds of disasters.

Keeping this requirement in to consideration, United Nations (UN) through its different agencies had always acted proactively to create a common universal framework for understanding impacts of different disasters and formulating ways to reduce these disasters through co-operations among nations through different global treaties and agreements. One such agreement was adopted during the world conference at Sendai, Japan in 2015 for reducing disaster risk known as Sendai Framework for Disaster Risk Reduction 2015-30 or SFDRR. It was expected that the framework will be adopted by all governments, local bodies and institutions and will synchronize their disaster management planning, policies and guidelines with SFDRR. By utilizing advancement in science, new technology and improved governance the institutions and governments will be able to achieve the disaster risk reduction targets.

India with the second largest population in the world has always extended its support to UN by accepting and adopting its guidelines in different human development programs including disaster management. The huge populations living in India are prone to different types of natural disasters. About 58.6% of Indian landmass comes under moderate to very high intensity earthquake risks. In India over 40 million hectares of land are prone to floods and soil erosion caused by rivers. Out of 7518 km. of total Indian coastline, about 5700 km. has the risk of disasters arising out of cyclonic storms and tsunami. Hilly areas are always in risk of landslides and avalanches[11].

Along with risks of natural disasters, Indian population faces risks of manmade disasters like chemical explosions, fire accidents, terrorist attacks, accidents due to technical and human failures etc. Trains in India are prone to all of these manmade and some of the above mentioned natural disasters. As Indian railways operate about 13452 passenger trains and 9141 goods train each day, a huge numbers of passenger lives and huge amount of money is always at stake due to risks of disasters. When it comes to the issue of dealing with these disasters, Indian Railway is different from many other railways working in different parts of the world. While in many other countries, the role of their railways, in case of a disaster, is limited to removing obstructions and restoring the train movement. However, in India, the Railway handles the rescue and relief operations along with traffic restoration.

This becomes duty of Indian Railways due to its 'Citizen Charter', which describes Indian Railways' commitment for providing safe and reliable train services to travelling public[1]. Indian Railways is an important government organization in India and it is expected that Indian Railways have aligned and synchronized its disaster management plans to the framework of SFDRR to reduce the disaster risk to its passengers, goods carried and country's railway properties. This study examined the actions initiated by Indian Railways in post 2015 period to synchronize its disaster management plans in line with the recommendations of SFDRR. The study also attempted to identify the gaps in disaster management plans of Indian Railways where more actions are to be taken.

The methodologies adopted are extensive study of available literatures both published and grey on SFDRR, disaster management plans of Indian Railways, accident manuals of zonal railways and reports of different UN organizations. As there is dearth of published literature on SFDRR and there is not much study available in Indian context, this study will be useful in formulating disaster management plans of many organizations. To identify the gaps in the present disaster management capabilities of Indian Railways, interview of some officials of India Railways was also conducted.

Sendai Framework for Disaster Risk Reduction: It was 18th march 2015, when 187 UN member countries agreed on a common disaster risk reduction framework at Sendai city of Japan popularly known as Sendai Framework for Disaster Risk Reduction 2015-30 (SFDRR) during 3rd UN world conference. This global agreement among nations came into force in place of earlier framework of action for reducing disaster risk signed on 22nd January, 2005 at Japanese city of Hyogo known as Hyogo Framework for Action i.e. HFA 2005-2015[17]. SFDRR was outcome of prolonged process of discussions involving different governments, experts, civil bodies and organizations at global to local levels.

The attempt to reduce disasters worldwide by United Nations through common policies and guidelines started with the Yokohama Strategy adopted in the year 1994. This was a guideline for reducing risk and effects of disasters by prevention, preparedness and mitigation actions. However, while reviewing the implementation of guidelines, several gaps and challenges in its implementation were noticed. The next attempt was Hyogo framework for action 2005-2015**.** In this framework it was resolved to substantially reduce losses in human lives, properties, environment and economies of world communities from disasters during the 2005-2015. However, during the review of achievements of Hyogo framework, it was noticed that there was no remarkable decrease in losses due to disaster during the period[16].

During this 3rd world conference, an assessment of performance of the Hyogo framework was conducted and it was noticed that during the 10 years (2005-15), disasters have resulted into deaths of over 700 thousand people, injuries to more than 1.4 million people and loss of more than 1.3 trillion USD. The rising rates of disasters made the world community recognize the urgent need to anticipate disaster risks and formulate plans to reduce disaster risks. The need to work hard in reducing the vulnerability and exposure to disasters which would reduce risks of new disasters were also realized by world community.

Understanding and disseminating the importance of Sendai framework for each and every sector is critical for reducing the vulnerability of hazards for members of that sector. Sendai framework stresses the need of creating capabilities of organizations and communities in forecasting, preventing, being prepared, responding and recovering in disaster. To achieve these capabilities, there is need of multi organizational or multi-sector approach instead of a single organization focusing on response after occurrence of disaster[22].

For reducing disaster risk in future, SFDRR had prioritized four actions to be carried at all levels and all sectors of governments, local bodies and institutions as shown in table 1[17]. The SFDRR was adopted to be applicable for all types of disaster risks starting from small to large, frequent to infrequent, slowly developing to sudden, natural to manmade and biological to technological. To monitor the progress of implementation and assess the outcome, SFDRR had fixed seven target goals to be achieved by all nations at all levels. These seven targets are summarized in table 2[17]. Being a voluntary mechanism, SFDRR encourages compliance through positive reinforce, different mechanism and inducement instead of punitive actions for non compliance[14].

SFDRR stresses need of creating collaborations among volunteers, volunteering organizations and local communities with public organization for reducing disaster risks. These collaborations should be part of disaster reduction frameworks and plans of every central Governments, organizations and institution.

Indian Railways: As of 31st March 2020, Indian Railways has 67,956 route kilometer of rail network covering 7,325 stations. The Indian Railways is the largest railway network in the world under a single administration with about 1254 thousand regular employees. During 2019-2020, a total of 8,086 million originating passengers and 1,208.413 million tons of originating goods were carried by Indian Railways[10]. The Indian Railways functions under a separate ministry under Government of India with a tri-level structure. At the apex is Railway Board which is headed by Chairman Railway Board. He is assisted by a numbers of board members responsible for different activities.

The total Indian Railways is divided into 17 zones each of which is headed by a General Manager. Except these zones also, there are many production units, Kolkata metro rail and some special purpose units each headed by a General Manager. Each of these zones is again divided into some divisions. At present, these 17 zones have a total 68 divisions each of which is controlled by a Divisional Railway Manager. Here it is to mention that Konkan railway and different urban metro railways are not part of Indian Railways. Due to its size, network spread and cheap cost of both passenger and goods transport, Indian Railway has always been termed as life line of India and had always played a major role in the development of the country and its economy both directly and indirectly. Indian Railways along with operations of trains also creates its own infrastructure by different organizations under its control. The track length, numbers of trains and average speed of trains had significantly increased in last 30 years.

Table 1
Sendai Disaster Risk Reduction Framework's four priorities

S.N.	Sendai Disaster Risk Reduction Framework priorities
1	Understanding disaster risk
2	Strengthening disaster risk governance to manage disaster risk
3	Investing in disaster risk reduction for resilience
4	Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction

Table 2
Sendai Disaster Risk Reduction Framework's seven target goals for achievement by 2030

S.N.	Sendai Disaster Risk Reduction Framework target goals
1	Substantially reduce global disaster mortality by 2030, aiming to lower average per 100,000 global mortality between 2020–2030 compared to 2005–2015.
2	Substantially reduce the number of affected people globally by 2030, aiming to lower the average global number per 100,000 between 2020–2030 compared to 2005–2015.
3	Reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030.
4	Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030.
5	Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020.
6	Substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of this framework by 2030.
7	Substantially increase the availability of and access to, multi-hazard early warning systems and disaster risk information and assessments to the people by 2030.

But at the same time due to huge number of train movement throughout the length and breadth passing through different geographical terrains, the possibilities of different types of train accidents have also increased. Many times these accidents change into disasters bringing threats to human lives and properties. In past, many train disasters had taken place in India causing huge loss of human lives and properties. Railway disasters can be due to both natural and or manmade causes. Some disasters which railways have to face from train related accidents are collisions between trains, derailments of trains, falling of coaches on water body from bridges due to derailment or other causes, fire in trains carrying passengers, explosions on trains due to carrying highly inflammable material or terrorist activities, collapsing of tunnels or road over bridges on trains, collisions on level crossing gates, flash floods causing marooning of trains and landslides on trains in hilly areas etc.

Disaster Management Structure of Indian Railways: In Indian Railways, like other activities, safety/disaster management is also controlled and monitored at tri-level. At the apex level, the safety directorate of Railway board with help of other departments like civil engineering, electrical engineering, signal and telecommunication engineering, operations department and security department prepares disaster management plan. Railway Board also monitors safety management activities carried out at zonal level by safety department of respective zones. These zones monitor activities of divisions under their jurisdiction. Indian Railways adopt a dual reporting structure where officials have a functional as well as administrative line of control. A hierarchical chart of the safety organization is shown in figure 1.

Concept of disaster in Indian Railways: Railway disasters in India during the pre independence era were less due to less number of trains. But after independence due to increase in train numbers, the existing railway infrastructure started becoming overloaded, resulting in much higher numbers of train disasters. But till 2005, there was lack of adequacy and comprehensiveness in the concept of disaster in Indian Railways. It was presumed that major train accidents can only be termed as railway disaster and were managed accordingly.

But after Govt. of India passing National Disaster Management Act 2005, every department started changing their understanding of disaster and aligned it with the principles of the new act. Basing on Government of India's disaster management act 2005, Indian railways formulated its own definition for disaster as "railway disaster is a serious train accident or an untoward event of grave nature, either on railway premises or arising out of railway activity, due to natural or man-made causes, that may lead to loss of many lives and/or grievous injuries to a large number of people, and/or severe disruption of traffic etc. necessitating large scale help from other government/non-government and private organizations"[9].

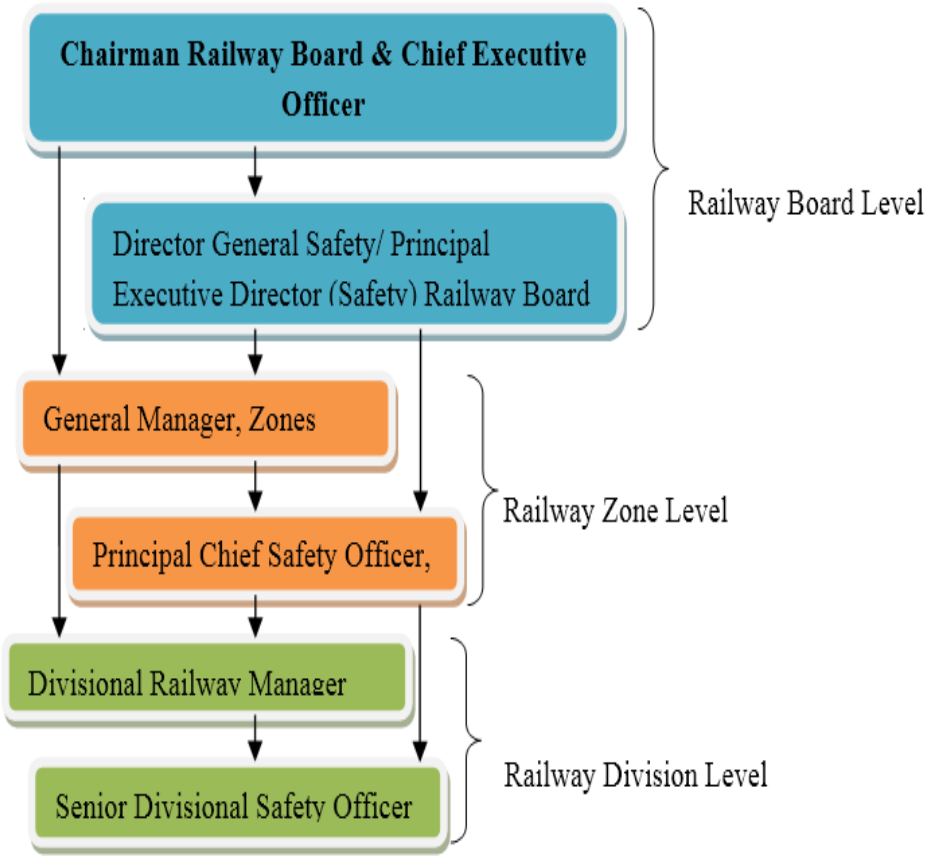

Fig. 1: Safety Organization of India Railways

Now the meaning of railway disaster is not limited to train collisions only, but is also extended to train mishaps due to natural causes like cyclone, tsunami, earthquake etc. and also manmade causes like terrorisms, sabotage etc. Another new dimension was added that a disaster normally cannot be handled by a single department and other central government departments including State Governments are expected to come forward for management of railway disaster. Indian Railway requests for help from units of central/state disaster management agencies like National Disaster Response Force (NDRF) and State Disaster Response Force (SDRF) situated within the railway zone or nearby zone in case of disasters whenever needed. The disaster management plan of Indian Railways is prepared by Railway Board. It prescribes principles for guidance of zones and divisions functioning at the ground level. So organizations at bottom of pyramid, who are actual executers of disaster management plans, are expected to have detail plans for each type of disasters.

Framework for Railway disaster management in India: A framework is the basic structure on which the intended outcome is built. It decides the shape and the boundary limit of the outcome. Framework helps in maintaining uniformity in the actions and results every time. Indian railways has adopted a new framework for managing railway disasters based on the philosophy of resource sharing with all state and central government departments concerned along with its' own resources to cope with challenging situations arising out of grave train accidents, different mishaps, terrorism activities and natural calamities. The National Disaster Management Plan (NDMP) of India guides the Indian Railways' disaster management framework.

After implementation of SFDRR, Indian Railway has modified its disaster management plan in the year 2019 issued by Railway Board for adoption and guidance of all zones and divisions of IR. It was an updated version which attempted to incorporate all four priorities of SFDRR. In this updated version of the disaster management plan, different chapters are exclusively identified and aligned with different priorities as shown in table 3[9]. This shows that Indian Railway recognizes the importance of SFDRR and attempted to align its own disaster management plan with that of SFDRR.

The advantageous position of Indian Railways in managing disasters: As compared to many other departments of Govt. of India and also state govt. departments, Indian Railway is in much comfortable position in dealing with disasters due to following reasons[9]:

1. IR is having its own huge network of communication. Each station is connected with a central control room situated at divisional head quarters. All divisions are connected to zonal head quarters.
2. Indian railway has a territorial army force comprising of railway employees who are trained to deal with disasters and emergency situation.
3. Indian railway maintains a scout and guide organization of its own where interested employees are given regular training and remain ready for attending any type of disaster in railways.
4. Indian railway has its own uniformed force namely Railway Protection Force (RPF) and Special Railway Protection Force (SRPF). Also railway maintains a state police force named as Government Railway Police (GRP).
5. Own medical infrastructure comprising of fully fledged hospitals, ambulances and medical teams.
6. Dedicated relief vans, medical vans and restoration vans having own cranes and other machineries.
7. An army of huge numbers of employees scattered throughout over the country.

Adoption of SFDRR 2015-30 by Indian Railways: Instead of adopting only a relief and rescue centric approach, Indian Railway has started to adopt a holistic approach to handle disasters by prevention, mitigation, preparedness, rescue, relief and rehabilitation. How four priorities for action under the Sendai framework 2015-30 have been incorporated into the disaster management plan of Indian Railways are analyzed.

SFDRR Priority 1 - Understanding Disaster Risk

The first priority of SFDRR stresses for assessing the existing knowledge both scientific and local, data available and technical capabilities on disaster monitoring, disaster reduction and disaster resilience. These data and knowledge are to be updated wherever necessary. Information gathering is to be done scientifically and to be analyzed to make it as useful knowledge.

This knowledge is to be disseminated across all levels and all sectors. Well informed policymakers will be able to formulate proper disaster risk reduction policies[18]. The understanding of disaster risk has to be in all aspects of disaster like its vulnerability, capability, exposure of people and assets, hazard nature and the environment.

The priority one of SFDRR had proposed a new paradigm in disaster management from earlier "disaster management" to "disaster risk reduction". Instead of responding after disaster has taken place, it is necessary to identify risks of disaster, assessing the possible extent of damage and prioritize the risks. Actions are to be planned according to disaster risk priorities.

So it can be said that policies and guidelines in disaster management should recognize the importance of understanding disaster risks in its all facets like vulnerability, types of hazard and possible extent of damage. The adoption of science and technology in understanding disaster risks by stakeholders will help in proper preparedness and effective response[13]. The first priority of the SFDRR framework can be achieved through integration of 1.

Table 3
Chapters of Indian Railways Disaster Management plan aligned to SFDRR 2015-30 priorities[9]

SFDRR priority number	Priority	Chapters of Indian Railway Disaster Management Plan aligned to the priority
1	Understanding disaster risk	Chapters 3, 12,13, 14, 16
2	Strengthening disaster risk governance to manage disaster risk	Chapters 3, 4, 5,6
3	Investing in disaster risk reduction for resilience	Chapters 3, 4, 5, 6, 7, 8, 9, 15
4	Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction	Chapters 4, 7, 15, 16,17,18

Observation, information gathering, analysis and forecasting 2. Zoning and mapping 3. Hazard risk and vulnerability assessment (HRVA) and 4. Monitoring, warning, dissemination of warnings and information. These above actions are crucial in reducing disaster risk and improving disaster resilience. At the same time, these actions will also improve risk understanding capability[9]. Indian railways complies these actions in their disaster management plan in following ways.

Observations, information gathering and analysis and forecasting: For this purpose, there is need for modernization of natural disaster observation networks, commissioning of different equipments, building information systems and adoption of land, ocean and satellite based observation systems. Along with maintaining data of cyclones and floods, modern technology for forecasting should be adopted. Continuous research should be carried out to improve the accuracy and increase the time gap between forecasting and actual occurrence. Indian railways does not have their own natural calamity forecasting systems and depends on agencies of states and central government like Indian Meteorological Department (IMD), department of space, department of earth science etc. for cyclone, flood and land slide forecasting. But there is clear distribution of responsibilities among Indian railway offices to continuously maintain close coordination with these organizations for early forecast and actions. At railway board level, civil engineering directorate (bridge), at zonal level head quarters, civil engineering dept. (bridge and flood) and at divisional level, civil engineering department (bridge and flood) are given responsibilities to maintain coordination with these departments to keep track of their predictions and forecasting.

Zoning and mapping: There is need for preparing maps showing areas prone to cyclones, landslides, floods, flash floods and earth quakes. Indian railway prepares and maintains maps showing areas which are prone to natural calamities. This mapping is done at divisional and zonal levels by civil engineering department supported and coordinated at railway board level. From the context of railway operations, zones prone to floods, flash floods and landslides are of utmost importance. At all bridges after studying previous flood levels, highest flood level (HFL) markings are given by Indian railway.

Hazard risk and vulnerability assessment (HRVA): Based on the disaster zoning and mapping, it is necessary to assess the probable impact on the community in case of occurrence of such disaster. Also there should be constant review of any change in HVRA due to different climatic change. In Indian railways, civil engineering department has been entrusted with responsibility of regular study and assessment of hazard risks. Ground level Indian railway officials on receiving of warnings start 24 hours patrolling of railway tracks and other installations to assess their status.

Monitoring, warning and dissemination of warnings and information: There is need of continuous monitoring of hazard risk either through own resources or through other reliable sources. Next step is intimating the warning to all concerned up to the lowest level in an understandable form is the main purpose of building a whole gamut of warning system. In Indian railway, a mechanism of dissemination of warnings through different communication technology is maintained. Civil engineering departments at railway board, zonal head quarters and divisional head quarters are entrusted with the responsibilities of maintaining constant co-ordination with state level organizations to get updates about warnings on natural calamities.

At the same time they disseminate these warnings to all departments to prepare themselves and be in constant vigil. Many times zonal railways in consultation with railway board cancel train movements. The public relation department issues bulletins for information of general citizens. Railway board works as coordinator among zones as well as central Govt. departments like Indian Meteorological Department (IMD) etc.

SFDRR Priority 2 - Strengthening disaster risk governance to manage disaster risk

Governance covers a whole gamut of stakeholders to form different organizations and relationship among them. Governance has three principal elements namely authority, decision making process and accountability[12]. Governance is driven by structures and processes adopted for delegating power, fixing responsibility, maintaining transparency, making stakeholders responsive and establishing rule of law. In the context of disaster risk governance, interrelated actions and processes of institutions bring down the impacts of disasters[15]. SFDRR describes what is to be done for

implementing disaster risk reduction and guides stakeholders about their role in this matter.

SFDRR believes that disaster risk governance at all levels is of utmost importance in management of disaster and its reduction in all sectors. It is necessary to ensure maintenance of coherency in national, institutional, organizational and local disaster risk governance frameworks, policies, technical guidelines and legal laws[3]. SFDRR terms these as non structural measures for risk reduction. At the same time capability to administer, execute and to keep a track on the measures undertaken to mitigate disasters at all levels are to be developed. Another integral part of governance is transparency in actions.

As governance controls the way power and authorities are conferred on individuals to make decisions, good governance systems should have good authorities. The concept of governance inescapably includes authority relations[4]. In Indian railway, the authority to make different decisions in disaster management process is clearly spelled out. For instant, the authority to declare any accident/untoward incidence as a disaster is conferred with General Managers of each zonal railway.

In his absence, additional general manager and chief safety officer are authorized to declare incidences as disaster. Only when the incidence is declared as a disaster, all disaster management mechanism comes to active form. For assessing the preparedness of Indian railway in managing disasters, periodical safety audits of different divisions are carried out by multi disciplinary teams from zonal headquarters or by inter railway safety audit teams. At the apex level, railway board reviews the safety performance of each zonal railway. Review meetings at railway board level are conducted by railway board chairman and other board members attended by general managers and chief safety officers of zones. Regular safety drives are done to increase staff awareness and also sensitize them on past mistakes which might have caused disasters so that similar mistakes can be avoided in future.[9]

As a step towards maintaining proper coordination with other central agencies engaged in disaster mitigation and response, the apex body of Indian railway, railway board had delegated powers to divisional railway managers to directly request for NDRF team for rescue operations, if situation demands so. NDRF national head office fixes annual meeting between safety department of zonal railways and NDRF officials. Every accident in railways is enquired by committees formed at appropriate level. Enquiry officials are nominated according to severity of accidents. For enquiry of railway disasters, a body under ministry of civil aviation named as commissioner of railway safety (CRS) functions. This body also examines implementation of safety parameters and guideline in Indian railway operations on regular basis and newly created infrastructures before putting them in to service for use of public. Reformative actions are taken by railway board and zonal railways according to recommendations of CRS.

Being under a separate ministry, impartiality and transparency can also be ensured. As far as responsibility of different departments of Indian railway is concerned, in risk identification, risk mitigation, preparedness and response are clearly described in zonal and divisional disaster management plans. Office of Comptroller and Auditor General of India also reviews disaster management. A separate organization under Indian railways namely research design and standard organization (RDSO) develops technical safety parameters for different equipments, machineries, parts and processes used by IR.

SFDRR Priority 3 - Investing in disaster risk reduction for resilience

Resilience is the capacity of a community or a system to absorb any adverse effect and bounce back. The word is used in different disciplines in different context. In the context of disaster, it is the ability of a community/ institution /nation to face the disaster and bounce back either to earlier state or a step forward. It is the robustness to absorb the stress resulting from hazards of a disaster without disturbing its basic function for long time. There are lot of recommendations prescribed by SFDRR 2015-30 to create disaster resilience at community, institutional and national level. There is lot of stress given on use of science and technology and enhancement of scientific knowledge for reducing risks in SFDRR 2015-30[20]. This study has focused on Indian railways action to adopt these recommendations.

According to SFDRR, to make the community resilience in terms of disaster risk, there has to be private and public investments for risk reduction in both structural and nonstructural way. Allocation of resources, funds, logistics and creation of infrastructures at all levels is necessary.

At the same time it is necessary to develop and implement sector specific disaster risk reduction plans, laws, policies and regulations. These measures cost less compared to the cost of disaster and are effective proactive actions to save lives, prevent and or bring down property losses and ensure effective recovery of affected[17]. Other measures suggested in SFDRR 2015-30 relevant to Indian railways are development of new and revised codes for disaster resistant buildings and other constructions.

Also it is suggested to invest in health systems for care of affected people, capacity enhancement of health workers and other workers by imparting training in disaster risk reduction areas. There are 16 zonal level hospitals run by IR located at zonal head quarters. Also 57 hospitals are maintained at divisional level. Except these, there are about 60 hospitals located at different important stations. There are 164 accident relief medical equipment (ARME) vans stationed at different important stations. Out of these, 77 numbers are

self propelled so that they can reach the disaster site quickly without depending for an engine[9].

There are also 171 accident relief trains (ART) kept ready round the clock to reach the accident site within very short notice. At the same time, zonal railways arrange mock drills each quarter in each division to test the readiness. There are 88 accident relief cranes located at different divisional head quarters throughout IR. Other structural actions initiated by Indian railways to reduce risk of disasters are:

1. Infrastructure development: During 2017-18 a special fund named as "rashtriya rail sanraksha kosh" (RRSK) was created for renewal or up gradation of assets related to safety. The fund was created for allocation of yearly funds to the tune of rupees 2000 million each year for five years. In the first year an amount of rupees 1609.1 million was spent for different safety related asset creation/ replacements[9]. These funds were used for carrying out safety related works for different traffic facilities, elimination of level crossing gates by flyovers/road under bridges, track replacement, bridge strengthening, improvement and modernization of signal and telecommunication systems etc.

A framework for monitoring of the performance of rashtriya rail sanraksha kosh has been created with Niti Ayog (the apex planning body of India) as head. Some of the infrastructural developments implemented to reduce disasters due to different kinds of rail accidents are discussed below[9].

2. Measures for avoidance of train collisions: Collisions of train may be either head on, end on or side on collision. Some disasters out of train collisions are shown in figure 2. At about more than 94% stations mechanical signaling which were making trains more prone to collisions are replaced with automatic Multi Aspect Color Light Signals (MACLS) working through either Panel Interlocking or Route Relay Interlocking (RRI) or Electronic Interlocking system. Also to avoid collisions in station areas, complete track circuiting at stations is being taken up in large scale.

Another measure named Automatic Train Protection (ATP) system using European Train Control System (ETCS) level 2 and indigenous Train Collision Avoidance System (TCAS) to avoid accidents due to passing danger signals and over speeding are also under commissioning in phased manner[9]. Some of disasters taken place due to collision of trains are shown in figure 2 and figure 3.

3. Measures to reduce derailments: To reduce derailments, IR started using of wider pre-stressed concrete sleepers (PSC), higher strength 60 kg rails, rail fracture detection systems and long welded rails. Other measures like rail fracture detection system used by many advanced railway systems are planned for Indian Railways. Long welded rails and flash-butt welding are used. In motion, weigh bridges are introduced to avoid overloading of wagons. One of disasters taken place due to derailment of train is shown in figure 4.

4. Measures to prevent fire accidents in trains: Fire and smoke detection and suppression system have been introduced in all new AC coaches, pantry cars and power generation cars. Provision of fire extinguishers in all these coaches is made. From time to time different guidelines and instructions are issued for pantry cars to follow. Also electrical department is issued guidelines to take actions to avoid fire due to short circuits in electrical systems of coaches. One of disasters due to fire on train is shown in figure 5.

5. Measures to prevent accidents at level crossings: For avoidance of accidents in level crossings, IR planned to eliminate all unmanned level crossings by either changing them to manned level crossings or by provision of road under bridges. Also IR in coordination with State Governments and National Highway Authority of India has prepared a massive plan for converting all important level crossings into road over bridges/flyovers[9].

During 2018-19, total 3479 numbers of unmanned level crossings and 631 numbers of manned level crossings were eliminated[9]. As of today, Indian Railway has removed all unmanned level crossings on its broad gauge section**.** Also in consultation with Ministry of Road Transport, it has formulated strategies and actions to prevent disasters in level crossings.

To achieve this, actions like creating speed breakers near level crossing gates, widening of roads in level crossings, provision of signals interlocked with level crossing gates, running awareness campaign among road users and running special safety classes for children in schools situated nearby level crossings are taken up.

Civil engineering directorate at railway board level in consultation with research design and standard organizations issues necessary guidelines, codes and specification for strengthening important railway structures. At zonal and divisional level, civil engineering departments ensure adoption of these guidelines and codes at field level. Civil engineering directorate (bridge) along with establishment directorate (personnel) develops training syllabus for safety training of employees. At zonal and divisional level, these are implemented by civil engineering and personnel departments[9].

SFDRR Priority 4 - Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and construction

Due to constant change in environmental condition, change in social structure and technical changes, a constant increase in disaster risks of people and assets is taking place.

Fig. 2: End on collision of trains (E.RLY.)

Fig. 3: Head on collision of trains (S.C. RLY.)

Fig. 4: Derailment of train in to water body (S.C. RLY.)

Fig. 5: Fire on train (N. RLY.)

According to SFDRR, lessons from earlier disasters and increasing disaster risks have made it clear that there is need to reinforce the disaster preparedness, need to take quick actions when disaster is anticipated and need to make sure that the facilities are ready for response in case of disaster. All these will help in recovery and reconstruction. SFDRR stresses need for preparing and periodical reviewing/ updating of plans and policies related to disaster preparedness by respective institutions and also facilitate involvement of all stakeholders[17].

Employees are to be trained and to be part of regular disaster drills to sharpen their ability to face disasters and react promptly. Setting up of area wise support systems can reduce time of response and restoration. Also there is need of creating proper databases of casualties and reasons of disaster for future learning. Indian Railway maintains full system of disaster preparedness in every divisional headquarters which are at 68 places in India to cover the whole network of it. Database of causalities and reason of disaster in Indian Railways are maintained. These data are available in Safety Information Management System of Indian Railways.

Indian Railways conducts through enquiry of each and every accident by different authorities according to graveness of the accident. It also conducts mock drills on disaster response and relief jointly with National Disaster Relief Force (NDRF). Every year, one to two such drills are conducted in each zone after coordination between Executive director, Safety directorate at Railway Board and DIG of NDRF. These drills are essential to test the readiness of railway safety team to attend the disastrous situation within minimum time. Zonal railways also arrange mock drills at all divisions each quarter within their jurisdiction where accident relief trains and accident relief medical equipment vans take participation. Any laxity and shortcomings discovered during mock drill are recorded for implementation in future.

Safety and disaster management courses are regularly conducted at railway training centers. Indian Railway Institute of Disaster Management (IRIDM), Bengaluru is set up to impart training on disasters arising out of train related accidents. It has a first of its kind virtual reality centre to simulate real disasters. Safety management trainings are also imparted to railway officials at Indian Railways Institute of Transport Management (IRITM), Lucknow[9]. Also there are many Central Training Institute and Zonal Training Institutes under railways where safety related training are imparted.

The concept of "build back better" in the context of railway disasters means the ability of railway to restore normalcy in train movement, rescuing and taking care of affected and injured passengers, helping them reaching their destinations and preserving the dead bodies till they are handed over to relatives of deceased. In the disaster management plan of Indian railway, authority is given to commercial department to arrange foods and drinks, arranging road transports for onward journey of affected passengers. Medical department is responsible for primary and advanced treatment of injured and also preserving dead bodies. Other technical departments are made responsible for quick restoration of normalcy in train operation.

Gaps in Disaster Management Plan of Indian Railways: For identifying gaps in the performance of disaster management plan of Indian Railways, we have analyzed audit reports of Comptroller and Auditor General (CAG) of India. This being an independent organization outside Railways, its reports are supposed to be non-biased in nature.

The disaster management plan of Indian Railways is based on broad guidelines of National Disaster Management Plan of India. Indian Railways had formulated disaster management plans at Railway Board level, zonal level and divisional levels. These are to be updated regularly every year January[9]. But it is noticed that only about 5 zones (out of 17) and about 32 divisions (out of 68) have modified their Disaster management plan in 2021. Contrary to Indian Railway disaster management plan's provisions, some divisions and zones have not updated their management plans for years.

In the post accident situation, there is need of conducting impartial and transparent investigations to identify reasons. Though Railway's implementation of its own safety guidelines and policies are monitored and examined by Commissioners of Railway Safety (CRS) under a separate ministry, in many cases their suggestions and recommendations are not implemented at operational level[2].

Though the Safety Information Management System maintained by Indian Railway has mentioned about the role of CRS, the disaster management plans are silent about the role of CRS. In the year 2012, Indian Railway formed a high level safety review committee to study the existing status of railway safety in India. The committee in its report had suggested many futuristic actions within next five years for improving safety standards in Indian Railways. But in spite of passing about 10 years, most of these suggestions are yet to be fully implemented.

Indian Railways undertake a lot of construction works for creating new assets like new lines, conversion of gauges, doubling or tripling of single lines and electrification of non electrified lines. As these construction activities takes place by side of running trains, any mistake may cause disasters for both passengers of running trains as well as people working in construction activities. So there should be planning for construction safety management. But in disaster management plans of Indian Railway, no special mention about construction safety is observed.

Conclusion

On examination of Indian Railways disaster management plan, zonal railway disaster management plans and divisional disaster management plans, it is noted that Indian Railway had made a paradigm shift in its approach from earlier rescue centric to disaster risk management in the post SFDRR periods. It also recognized the need to upgrade its disaster preparedness. But there are number of areas where IR has to improve its capability in handling disasters. Though IR has strengthened its infrastructure, in many cases these are not properly placed resulting into delay in reaching the accident locations. To overcome this problem, IR should plan for having tie ups with private and local agencies by having proper co-ordination mechanism in place at every level which is also the spirit of third priority in the Sendai framework.

This discussion is limited to only Indian Railways disaster management plans. Other railways in India like Konkan railway and different metro railways are not covered in this discussion. This study has discussed only the implementation of four priorities of SFDRR by Indian Railways without assessing their achievement till date.

A detail study on performance of Indian Railway in reducing the disaster risks in their network by comparing disaster data of pre SFDRR and post SFDRR periods can be conducted using statistical tools. Such a study would help Indian Railways understand its progress in achieving the targets of SFDRR and decide its future planning in disaster management.

Lastly it is to be remembered that reducing disaster risks is not a onetime done and forgotten action. Rather it is a continuous process where organizations have to think, plan and resolute well before occurrence of disaster instead of providing resources late after happening of the disaster. Then only the targets of Sendai framework for disaster risk reduction 2015-30 (SFDRR) can be achieved.

References

1. Comptroller and Auditor General of India, Chapter 1 of Report No. PA 8, Disaster Management in Indian Railways **(2008)**

2. Comptroller and Auditor General of India, Disaster Management in Indian Railways, Chapter 6, Report No. 13 **(2016)**

3. Deeming H., Disaster Risk Reduction and the Sendai Framework What does it mean for UK resilience practitioners ? **(2017)**

4. Glaser J., From Governance to Authority Relations?, In Reconfiguring Knowledge Production, Changing Authority Relationships in the Sciences and their Consequences for Intellectual Innovation, 1st ed., Oxford University Press, https://doi.org/10.1093/acprof, 357–369 **(2010)**

5. Gopalakrishnan S., Disasters & Fundamental Aspects of Disaster Management Program, Dept. of Community Medicine, Sree Balaji Medical College & Hospital, www. commedsbmch.com **(2019)**

6. Kelman I., Progress in Disaster Science, *Progress in Disaster Science*, https://doi.org/10.1016/j.pdisas.2019.100008 **(2019)**

7. Lemos M.C. and Agrawal A., Environmental Governance, *Annual Review of Environment and Resources*, https://doi.org/10.1146/annurev.energy.31.042605.135621, **31(1)**, 297–325 **(2006)**

8. Ministry of Home Affairs, Govt. of India, Disaster Management In India **(2011)**

9. Ministry of Railways, Disaster management plan, Railway Board, Government of India, 1–162 **(2019)**

10. Ministry of Railways, Indian Railways Year Book 2019-20, Directorate of Statistics and Economics, Ministry of Railways, Govt. of India **(2019)**

11. National Disaster Management Authority, National Policy on Disaster Management 2009, Ministry of Home Affairs, Government of India **(2009)**

12. Pierre J. and Peters B.G., Governing Complex Societies, Palgrave Macmillan **(2005)**

13. Rahman A. and Fang C., Progress in Disaster Science Appraisal of gaps and challenges in Sendai Framework for Disaster Risk Reduction priority 1 through the lens of science, technology and innovation, *Progress in Disaster Science*, https://doi.org/10.1016/j.pdisas.2019.100006 **(2019)**

14. Raju E. and da Costa K., Governance in the Sendai: a way ahead?, *Disaster Prevention and Management: An International Journal*, https://doi.org/10.1108/DPM-08-2017-0190, **27(3)**, 278–291 **(2018)**

15. Tierney K., Disaster Governance: Social, Political and Economic Dimensions, *Annual Review of Environment and Resources*, **37**, https://doi.org/10.1146/annurev-environ-020911-095618, 341–363 **(2012)**

16. UNISDR, Hyogo Framework for Action 2005-2015, Building the Resilience of Nations and Communities to Disasters, www.unisdr.org/wcdr **(2015)**

17. UNISDR, Sendai Framework for Disaster Risk Reduction 2015-2030, UNISDR, www.preventionweb.net/go/sfdrr **(2015)**

18. UNISDR, The Science and Technology Roadmap to Support the Implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030 **(2016)**

19. United Nations, UNISDR Terminology on Disaster Risk Reduction, United Nations Strategy for Disaster Reduction (UNISDR) **(2009)**

20. Wannous C. and Velasquez G., UNISDR's Contribution to Science and Technology for Disaster Risk Reduction and the Role of the International Consortium on Landslides (ICL), 4th World Landslide Forum, https://doi.org/10.1007/978-3-319-59469-9, 109–115 **(2017)**

21. World Conference on Natural Disaster Reduction, Yokohama Strategy and Plan of Action for a Safer World, https://www.ifrc.org/Docs/idrl/I248EN.pdf **(1994)**

22. Wright N., Fagan L., Lapitan J.M., Kayano R., Abrahams J., Huda Q. and Murray V., Health Emergency and Disaster Risk Management : Five Years into Implementation of the Sendai Framework, *International Journal of Disaster Risk Science*, https://doi.org/10.1007/s13753-020-00274-x, **11(2)**, 206–217 **(2020)**.

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