APPLICATION OF REMOTE SENSING AND GIS IN EARTHQUAKE STUDY "A CASE STUDY OF BHUJ EARTHQUAKE 2001"

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ABSTRACT

The present paper attempts to study the principal causes of the damage that took place in Gujarat after the January 26, 2001 earthquake. A disaster management plan has also been evolved which can be useful for handling the situation in future. From the study it has been inferred that there have been a multiplicity of causes that have caused damage to life and property in Gujarat. The use of satellite imagery and remote sensing techniques can play a vital role in the earthquake disaster management in the short run as well as in the long run.

INTRODUCTION

Natural hazards and catastrophes are recurring phenomenon which affects one or the other part of the world every now and then of all such hazards the most devastating are the earthquakes with intensity over 5 on Richter scale. This is because occurrence of earthquakes is very uncertain. It can neither be predicted nor forecast. Its intensity and magnitude is known only after the earthquake has actually occurred in a region and causes immense destruction and loss of life. This requires all time preparedness for the authorities and the people.

STUDY AREA

The present study (fig –1) area lies between 22^0 46 N to 24^0 35 N latitude and 69^0 E to 71^0 E longitude. The region is flanked by the Rann of Kachchh in the North and Gulf of Kachchh in the south. Seismically it is one of the most active region of India lying in Zone V of Seismic Hazard map. Before the earthquake of 26th January 2001 the region has experienced several earthquakes ranging from ML (4 to 8 and intensities between III and X + (MM). Among the past earthquakes the most well documented are 1819 earthquake which racked the region on 16th June 1819 and the 1956 Anjar earthquake of M 6.1 on Richter Scale.

MATERIAL USED

In this study IRS WiFS and IRS 1D LISS III Remote Sensing Satellite data i.e. different dates in black and white and colour composites with the help of computer were used for visual interpretation. The false colour composite RS data of 1 : 250,000 was brought on 1 : 100,000 scale to make the study comprehensive. With the help of digital analysis the zoomed four site of pre and post earthquake was analysed by visual interpretation technique. Indian topographical sheets and maps were also used for study purpose. For the visual interpretation the remotely sensed data and ground truth data have been collected from the field. Apart from the data inferred from the satellite images, digital data, topographical maps and field survey, the relevant data were also collected from secondary sources.

EVENT

A massive earthquake measuring 7.9 on Richter scale hit Gujarat on 26th January 2001 at 8.46 a.m. Its epicenter was located 20Kms NNE of Bhuj and its seismic focus was at a depth of 22Kms below the crust. The earthquake left a trail of massive destruction in terms of both life and property. It affected 21 districts and a population of 1.58 crores. An estimated 25,000 people were killed, 1.6 lakh injured and property worth 21,500 crores was damaged. Four major urban centers Bhuj, Rapar, Anjar and Bhachau suffered near total destruction while other urban centers like Ahemdabad, Gandhidham etc. too suffered major damages. Like urban centers rural areas also suffered massive destruction with over 800 villages totally destroyed.

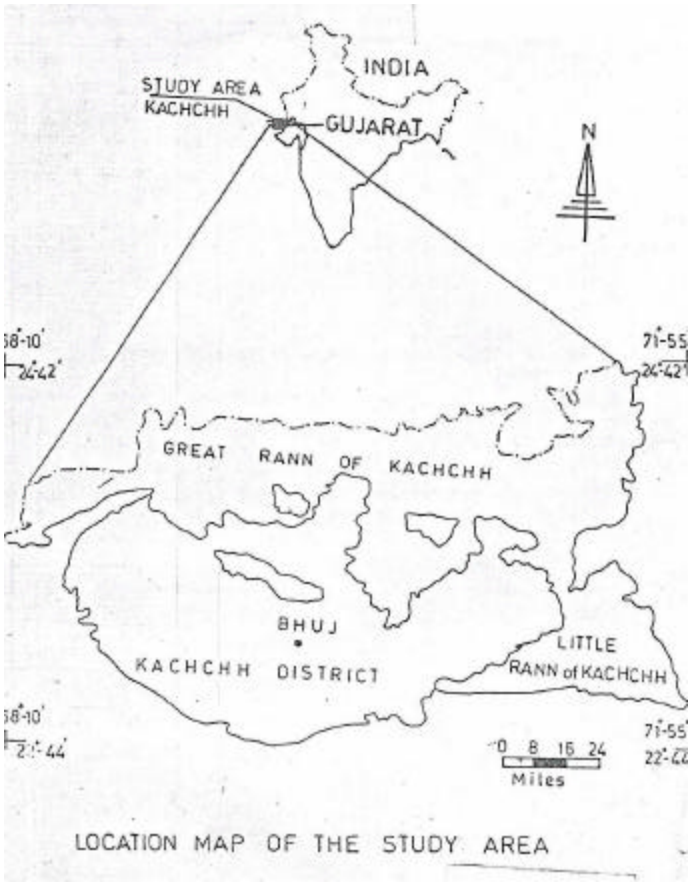


FIG. 1

CAUSES

Numerous factors have been responsible for the massive loss of life and property in Gujarat. At the outset the earthquake in itself was of such a high intensity that it within a few seconds of its occurrence it left behind a trail of massive destruction. An important cause has been the faulty building structures both in rural and urban areas which were not in conformity of such seismic areas. Consequently these structures could not withstand the shocks, got destroyed thereby causing numerous deaths. Any disaster of such a huge magnitude and dimension as the one which took place in Gujarat always poses several difficulties and problems before any administration. It takes some time before the authorities can understand and gain control over the situation. The government of Gujarat and the district authorities were no exception to it. Despite every effort considerable amount of valuable time was lost before the government could fully understand the situation, gain control over it and take up the rescue and relief work. This cost many lives which could otherwise have been saved. Non availability of hazard and route maps and insufficient stock of basic equipment like cranes, bulldozers, gas cutters etc. further

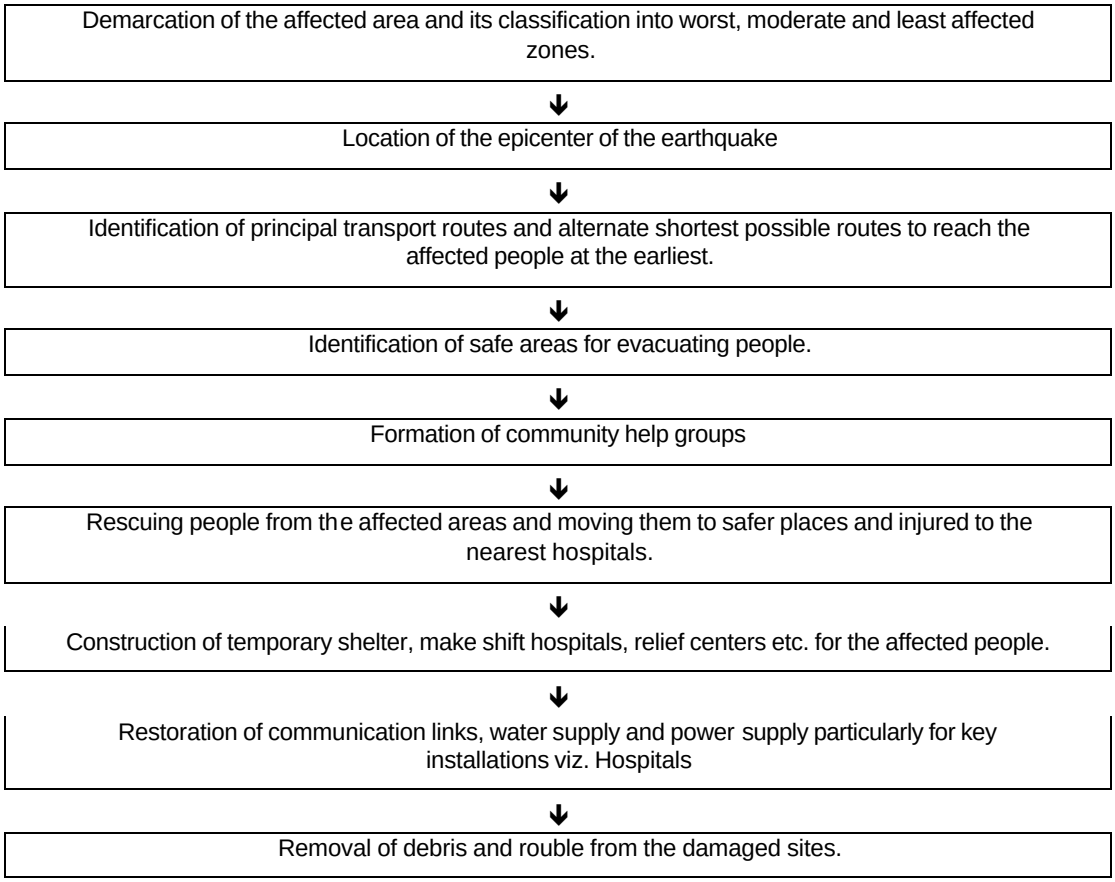
aggravated the situation. Complete disruption of communication links crippled the state authorities as they could not get the picture of the whole situation at the earliest possible time so that a quick action plan could have been evolved. Further the collapse of key government installations like collector's office in Bhuj, city hospital in Bhuj etc severely hampered the coordination of relief work. Destruction of important road and railway links also made it very difficult for the rescue teams to reach the affected areas and people swiftly, causing loss of life in remote villages and towns. Finally due to complete lack of awareness about earthquakes the people did not know how to react when the earthquake took place.

DISASTER MANAGEMENT

The earthquake in Gujarat has aroused the need for having a suitable disaster management scheme to effectively handle the situation in future. This has to be done at two levels. One immediately after the earthquake has occurred and second long term disaster management.

Immediately after an earthquake the primary concern is to know the extent of area affected and reach, evacuate and provide relief and medical help to the affected people. The underlying Flow Chart – 1 summarizes the action plan.

POST EARTHQUAKE DISASTER MANAGEMENT ACTION PLAN

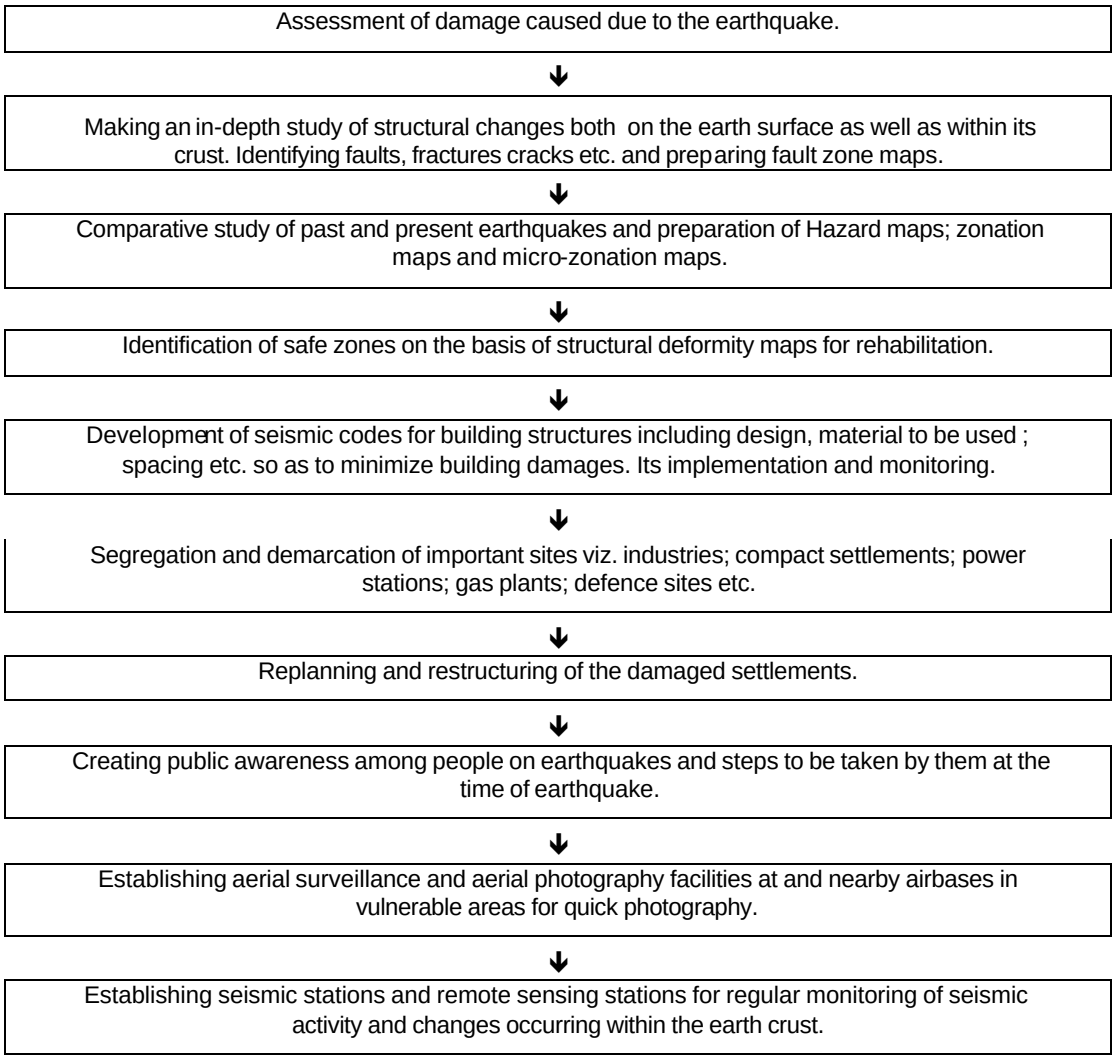


Flow Chart - 1

In the long run an in-depth study of the structural deformities and changes that have taken place on the earth surface as well as within it due the earthquake like formation of faults, cracks, ruptures folds etc. need to be made and detailed fault zone maps, geological maps etc need to be developed on a regular basis. Secondly an in-depth study of the past and present seismic activity needs to be undertaken on the basis of which hazard maps, seismic zonation and microzonation maps need to be developed. Thirdly a complete restructuring of the settlements needs to be done strictly in compliance with seismic codes

which include proper design and structure of the buildings; spacing between them and material used so that the affect of earthquake is minimized. Also safer areas away from fault zones need to be identified for rehabilitation purposes. Fourthly facilities for Aerial photography need to be established at the airbases in such vulnerable zones so that immediate reconnaissance maps can be developed at the time of such catastrophes and transmitted to the authorities for quick action plan. Fifthly the people need to be educated on how to react at the time of such earthquakes so that they are able to save themselves. For this print media; T.V., radio etc. can be used. Also experts can move into remote areas and organize demonstration camps. Flow Chart - 2 summarizes long term action plan.

LONG RUN DISASTER MANAGEMENT ACTION PLAN



Flow Chart - 2

METHODOLOGY

Remote Sensing Aerial photography and GIS provide us with tools to carry out the above said disaster management plan. The assessment and demarcation of earthquake affected area can be done through quick aerial photography after an earthquake. Classification of damaged areas into worst, moderate and least affected areas can be done through the use of different colour tones on the satellite imageries and aerial photographs. Safe habitation zones can be demarcated with the help of structural deformities visualized through satellite imagery taken after the earthquake. Usually these areas would be plain open

areas free from crustal fractures, ruptures, folds etc.. With the help of GPS the shortest alternate routes can be found out for reaching the affected areas.

RESULTS AND CONCLUSIONS

For an earthquake prone area like Gujarat disaster management scheme is extremely necessary. The various steps proposed in the flow charts 1 and 2 can be very useful in effectively combating the situation. The demarcation and classification of the affected area into worst, moderate and least affected areas can help the administration and relief workers to plan out which areas to be reached first. Similarly route maps can help these teams to reach the affected areas at the earliest. Establishment of aerial photography facilities at air bases in the vulnerable areas and near it can help in quick generation of air photographs and maps so that no valuable time is lost in undertaking relief work. Fault zone maps and structural deformities maps will be helpful in the location of safe areas so that there is minimum effect of earthquake on the settlements in future. Public awareness about earthquake will help people to take appropriate steps at the time of earthquake and thus save their lives thereby minimizing the loss of life.

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